U.S. Department
of Transportation
**Urban Mass
Transportation
Administration**

UMTA-MA-06-0049-82-12
DOT-TSC-UMTA-82-56

Houston North Freeway Contraflow Lane Demonstration

Final Report
December 1982

UMTA/TSC Project Evaluation Series
Service and Management Demonstrations Program

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTA-MA-06-0049-82-12		

4. Title and Subtitle HOUSTON NORTH FREEWAY CONTRAFLOW LANE DEMONSTRATION	5. Report Date December 1982
	6. Performing Organization Code DTS-64
7. Author(s) Terry J. Atherton, Ellyn S. Eder	8. Performing Organization Report No. DOT-TSC-UMTA-82-56
9. Performing Organization Name and Address Cambridge Systematics, Inc.* 238 Main Street Cambridge, MA 02142	10. Work Unit No. (TRAIS) UM227/R2676
	11. Contract or Grant No. DOT-TSC-1405
12. Sponsoring Agency Name and Address U.S. Department of Transportation Urban Mass Transportation Administration Office of Technical Assistance Office of Service and Management Demonstrations Washington DC 20590	13. Type of Report and Period Covered Final Report 1/75 - 12/81
	14. Sponsoring Agency Code URT-30

15. Supplementary Notes

*Under contract to: U.S. Department of Transportation
Research and Special Programs Administration
Transportation Systems Center
Cambridge MA 02142

16. Abstract

This report presents an evaluation of the impacts associated with contraflow operation of Houston's North Freeway under UMTA's Service and Management Demonstrations Program. In the Houston demonstration, a 9.6 mile contraflow lane was available for use by buses and vanpools during the morning and afternoon peak periods. In addition to the contraflow lane, a number of other transportation improvements were also implemented in the North Freeway corridor. In particular, bus service was expanded considerably and two park-and-ride lots were built and a third leased from a church.

The evaluation focuses on the feasibility (in terms of adverse impacts on non-priority users, safety, enforcement, public acceptance, etc.) and effectiveness (in terms of utilization, increased bus and vanpool ridership, etc.) of the contraflow lane. Contraflow operation resulted in an average round-trip travel-time savings of 40 minutes for bus riders and vanpoolers using the contraflow lane during the peak hour. As a result, bus ridership and, to a lesser extent, vanpooling increased considerably. The feasibility of contraflow operation as an HOV priority measure was also demonstrated by this project.

17. Key Words	18. Distribution Statement
Contraflow Lane, Demonstration Project, HOV, Transit Ridership, Vanpooling	DOCUMENT IS AVAILABLE THROUGH SUPERINTENDENT OF DOCUMENTS U.S. GOVERNMENT PRINTING OFFICE WASHINGTON DC 20402

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	308	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

PREFACE

This document was prepared under Task Directive DOT-TSC-1405-23 as part of the Service and Management Demonstrations Program sponsored by the Urban Mass Transportation Administration (UMTA) Office of Service and Management Demonstrations. This report presents the final evaluation of the impacts associated with the implementation of a contraflow lane on the North Freeway in Houston, Texas, on August 28, 1979. The evaluation focuses primarily on the feasibility and effectiveness of contraflow operation as a high occupancy vehicle (HOV) priority measure.

Cambridge Systematics had primary responsibility for the evaluation of the demonstration project. Ellyn Eder, Cambridge Systematics' project manager for most of the evaluation effort, and Terry Atherton are the principal authors of this report. John Suhrbier, also with Cambridge Systematics, and Fred Wagner of Wagner-McGee Associates also contributed to the evaluation effort. The Metropolitan Transit Authority of Harris County (METRO), assisted by its data collection contractors, Beiswenger, Hoch and Associates, Inc., and the Texas Transportation Institute, was responsible for administering the surveys used to obtain the travel data supporting the evaluation effort. In particular, the efforts of METRO's project manager, Charles A. Fuhs, in coordinating the data collection effort are greatly appreciated.

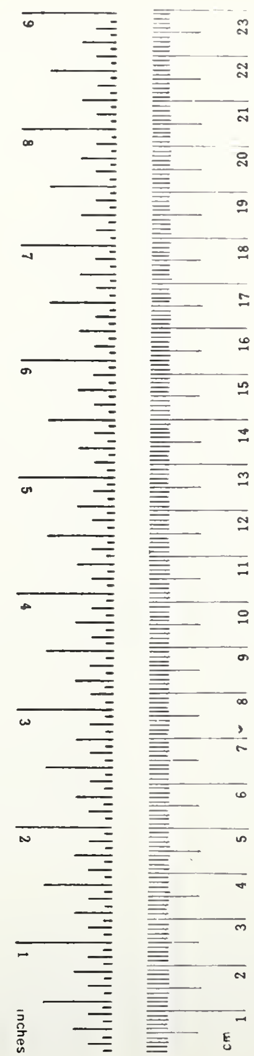
Valuable suggestions and guidance for this evaluation were provided by David Damm and Carla Heaton of the Transportation Systems Center, and Joseph Goodman, the UMTA project manager.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

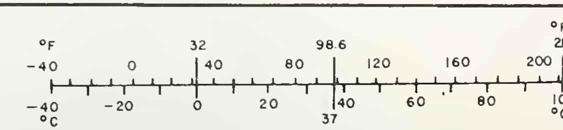
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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EXECUTIVE SUMMARY

PROJECT DESCRIPTION

On August 28, 1979, the Metropolitan Transit Authority of Harris County (METRO), in cooperation with the Texas State Department of Highways and Public Transportation (SDHPT) and the Urban Mass Transportation Administration (UMTA) began operation of a contraflow lane on the North Freeway as one element of a comprehensive corridor transportation improvement program. In addition to Section 5 Capital Grant Assistance, UMTA's support for the contraflow lane project also included a Section 6 Service and Methods Demonstration (SMD) grant for an 18-month demonstration period.

As shown in Figure ES-1, contraflow operation of the North Freeway extended north of downtown Houston to the North Shepherd Drive interchange, a distance of 9.6 miles. A contraflow lane was available for use by authorized buses and vanpools travelling inbound on the North Freeway between the hours of 6:00 AM and 8:30 AM and outbound between 4:00 PM and 6:30 PM. However, due to the time needed to set up and take down the contraflow lane (i.e., placing pylons, opening gates, etc.), the number of lanes available for off-peak direction travel was reduced by one from 4:30 to 9:30 in the morning (outbound) and from 2:30 to 7:30 in the afternoon (inbound).[1]

The North Freeway contraflow lane had a number of unique features which made it a more ambitious project than other HOV contraflow lane projects. Specifically:

1. at 9.6 miles, it was the longest;
2. it was in operation during both morning and afternoon peak periods; and
3. it was available for use by authorized vanpools as well as buses (see Figure ES-2).

In addition to the contraflow lane, there were a number of other improvements in transportation services implemented in the North Freeway

[1]Since the completion of the 18-month demonstration period, the time needed for set-up and take-down operations was reduced by almost half by deploying two crews at different points on the contraflow lane.

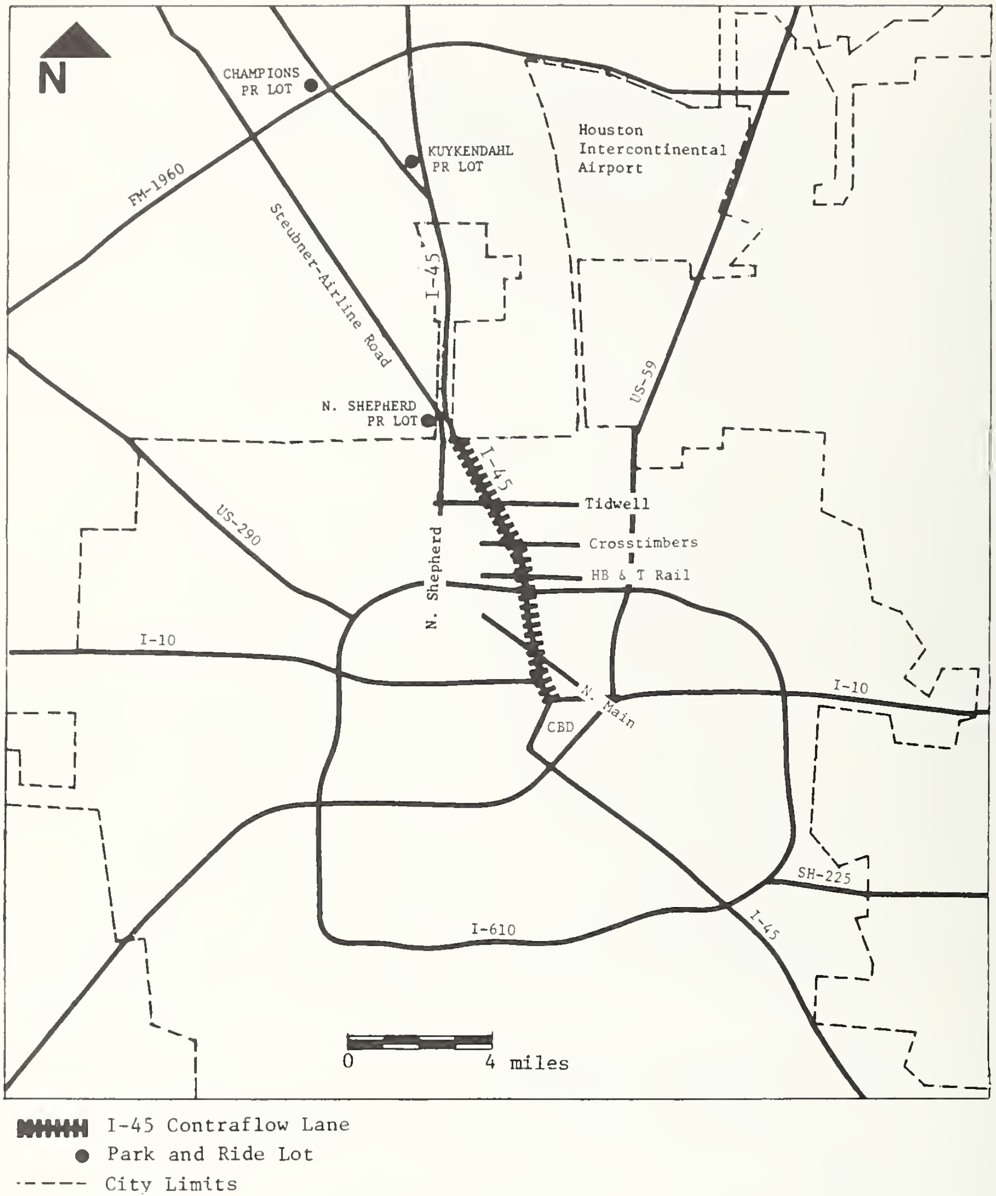


FIGURE ES-1. HOUSTON FREEWAYS AND CONTRAFLOW LANE

FIGURE ES-2. USE OF CONTRAFLOW LANE BY BOTH VANPOOLS AND BUSES corridor. These included the construction and operation of suburban park-and-ride lots, the expansion of express bus service to downtown, and the expansion of the already established CarShare regional ridesharing brokerage program to include vanpooling. While these associated projects were not funded by UMTA's SMD program, it would be difficult to discuss and analyze the contraflow lane without describing these other improvements and their relative impacts in the North Freeway corridor.

PROJECT OBJECTIVES

The concept of contraflow operation is by no means new. Excess off-peak direction capacity has been utilized for peak direction travel on bridges and other facilities for a number of years primarily as a means of increasing peak direction capacity without undertaking a major construction project. In the context of this application, though, use of the contraflow lane is restricted to develop a travel time advantage for high occupancy vehicles (HOVs). This type of contraflow project, then, has the additional objectives shared by other types of HOV priority treatment projects. In general, these would include increased average vehicle occupancy, more efficient freeway operation, reduced fuel consumption and vehicle emissions, etc.

METRO's objectives in implementing both the contraflow lane and associated corridor improvements were to:

1. decrease (or slow the growth of) corridor vehicle miles of travel (VMT) and associated fuel consumption and vehicle emissions;

2. increase vehicle occupancy in the corridor;

3. reduce congestion and, thus, decrease travel time; and

4. encourage acceptance and usage of public transportation.

Specific goals of the UMTA SMD program in funding this contraflow lane project included the following:

1. assess the conditions influencing the feasibility of high-occupancy vehicle contraflow lane operation (e.g., directional split, safety, enforcement, etc.);

FIGURE ES-3. RESTRICTION OF CONTRAFLOW LANE TO HOVs
TO DEVELOP TRAVEL TIME ADVANTAGE

2. measure the effect of HOV contraflow lane operation on mode choice, corridor VMT, freeway congestion, and related travel conditions;

3. investigate the nature of the relationship between the contraflow lane and other corridor improvements; and

4. explore the distribution of costs and benefits associated with contraflow operations.

EVALUATION ISSUES

In assessing the extent to which these objectives were achieved, the evaluation focused on the following areas:

1. Person and vehicle utilization;

2. Characteristics of both contraflow lane users and non-priority travellers;

3. Impact on non-priority users of the freeway;

4. Influence in promoting bus and vanpool use relative to other corridor improvements;

5. Associated safety and enforcement issues;

6. Public acceptance;

7. Impacts on corridor VMT, fuel consumption and vehicle emissions; and

8. Associated costs.

KEY FINDINGS

Impact on Travel Conditions

1. Use of the contraflow lane during the peak hour resulted in an average round trip travel time savings of 40-minutes for bus riders and vanpoolers. Prior to contraflow operation, average speeds for the 9.6 mile segment of the North Freeway corresponding to the location of the contraflow lane were 24 miles per hour during the morning peak hour and 16 miles per hour during the afternoon peak

hour. When contraflow operation was implemented, travel was essentially free flow at a speed of 55 miles per hour on the contraflow lane, resulting in average peak hour travel time savings of 14.5 minutes in the morning and 25.5 minutes in the afternoon for buses and vanpools.

2. Peak direction travellers in non-priority lanes also experienced a savings in travel time during the initial months of contraflow operation. As a result of shifts in mode to contraflow buses and vanpools, travel conditions in the peak direction non-priority lanes improved somewhat, resulting in a 12-minute savings in travel time on a round-trip basis. Over time, though, growth in corridor traffic appears to have worsened travel conditions somewhat, so that eventually travel times gradually increased to their original levels.

3. Off-peak direction travellers on the North Freeway initially experienced a 4-minute increase in travel time. As a result of ramp closures, this increase was subsequently reduced to about one minute. However, those off-peak travellers diverted from the freeway to frontage roads experienced a further increase in travel time.

Traveller Response

1. Average peak period bus ridership on the North Freeway increased by 1600 percent after 33 months of contraflow operation. Immediately prior to contraflow operation, average peak period bus ridership was 265. After 33 months, this had increased to over 4,500. During this same time period, transit services were also expanded significantly. In addition to providing three park-and-ride facilities, METRO increased the amount of bus service from an average of 7 trips per peak period immediately prior to contraflow operation to 103 trips by May 1982.

2. The contraflow lane appeared to have little impact on vanpooling during the first two years of operation. Average peak period vanpool ridership on the contraflow lane increased from about 770 during the first week of contraflow operation to 2,700 after two years--an increase of 273 percent. In terms of all vanpooling throughout the Houston region, though, the proportion of vanpools operating in the North Freeway corridor decreased from 18 to 15 percent during this period. Subsequently, vanpooling on the contraflow lane increased at a much higher rate, and by July 1982 the proportion of Houston's vanpools operating in the North Freeway corridor had increased to 19 percent.

3. Use of the contraflow lane has nearly doubled that for the average non-priority lane. As shown in Figure ES-4, at the end of 33 months of operation, an average of 7,400 people were travelling on the contraflow lane during each peak period, which was more than 80 percent greater than the average for peak-direction non-priority lanes (4,390).

4. As a result of increased vanpooling and bus ridership, average vehicle occupancy on the North Freeway increased by 30 percent. Prior to contraflow operation (August 1979), the average vehicle occupancy during the morning peak hour was 1.15. By May 1982, this had increased to 1.50.

Relationship Among Corridor Improvements

1. The relationship between the contraflow lane and improved bus service is best characteristized as mutually supportive in nature. If the contraflow lane had been implemented without expanding bus service, many people would not have been able to take advantage of the travel time savings afforded by the contraflow lane. Similarly, if bus service had been expanded without the contraflow lane, the increase in ridership would have been considerably lower.

2. To a certain extent transit and vanpooling are competing as alternatives to auto in the North Freeway corridor. While the number of vanpools using the contraflow lane increased at about the same rate as vanpooling in the Houston region, it did so despite the substantial improvements made to bus service. It is conceivable, then, that had bus service not been improved, many of those who had chosen to ride the bus may have instead vanpooled. Evidence of the competitive nature of the relationship between bus and vanpool is found in changes in the rate of increase for vanpooling which coincide with major changes in bus supply characteristics.

Travel-Related Impacts

1. The increase in bus and vanpool ridership has resulted in a decrease in the auto mode share from .934 immediately prior to contraflow operation to .797 about 15 months later. The decrease in auto, though, occurred primarily among carpoolers. For example, while the mode share for drive alone autos decreased by 3.2 percent (from .565 to .547) that for carpools dropped by 32.3 percent (from .369 to .250).

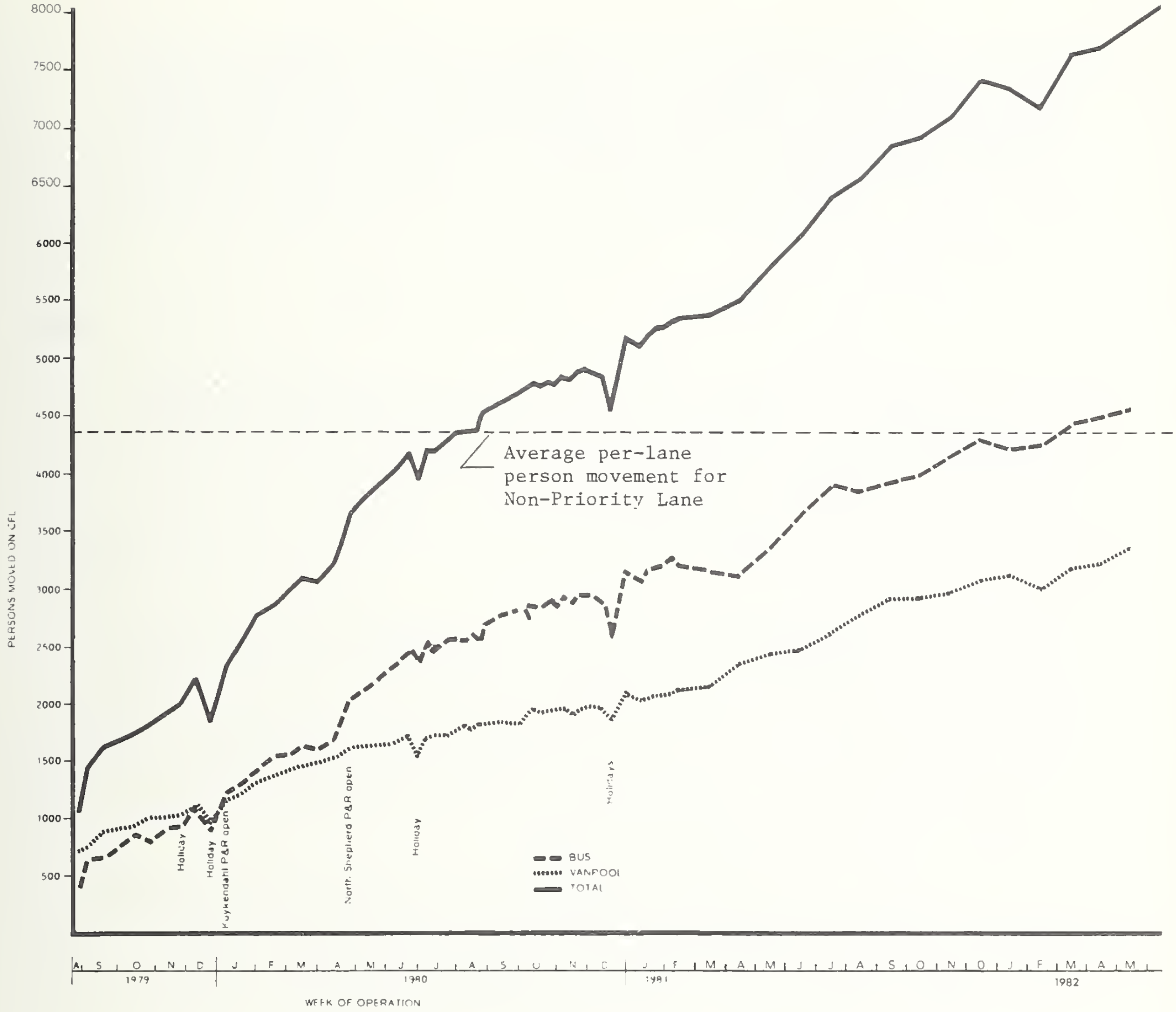


FIGURE ES-4. AVERAGE PEAK PERIOD PERSON VOLUME ON THE CONTRA FLOW LANE

2. After 15 months of contraflow operation, vehicle miles of travel (VMT) on the North Freeway was 7.4 percent lower than what it would have been had the contraflow lane and other corridor improvements not been implemented. Corresponding to this reduced level of VMT, fuel consumption was down by 5.8 percent, carbon monoxide emissions by 7.7 percent, hydrocarbons by 4.2 percent, and nitrious oxides by 4.7 percent.

Feasibility

1. The accident rate on the North Freeway decreased by 12.5 percent with contraflow operation. During the 6-month period prior to contra-flow operation, there were an average of 2.4 accidents per million vehicle-miles (mvm) on that portion of the North Freeway influenced by contraflow operation. During the 6-month period after the contraflow lane was opened, the accident rate had dropped to 2.1 accidents per mvm.

2. The incidence of violations was quite low, averaging about 14 unauthorized entries or attempted entries onto the contraflow lane per month. This can be attributed to two factors. First, there was only one access point for entry to the contraflow lane (versus almost continuous access for non-separated concurrent flow priority treatment projects). Second, since only buses and vanpools were allowed access to the contraflow lane, autos attempting to enter the lane were very visible as violators.

3. Contraflow operation of the North Freeway was accepted quite well by both the public and media. To a large extent this can be attributed to both the limited number of people adversely affected by the contraflow lane (i.e., off-peak direction travellers) and the relatively small magnitude of these adverse impacts.

4. The feasibility of contraflow operation is very dependent on traffic conditions in the off-peak direction of travel. In Houston, the rapid growth of population and employment in the North Freeway corridor has led to increased off-peak direction travel and deter- iorating travel conditions. As a result, METRO is replacing the North Freeway contraflow lane with a reversible median lane. In addition, METRO has plans for constructing similar facilities on other major freeways in the Houston region.

COSTS AND BENEFITS

Capital costs associated with construction of the contraflow lane totaled $2.2 million, 93 percent of which was funded by the Urban Mass Transportation Administration (UMTA) through a Section 5 capital assistance grant and, to a lesser extent, through a Section 6 Service and Methods Demonstration (SMD) grant. Local matching funds to cover the remaining costs were provided by the City of Houston and the Texas Public Transportation Fund. The Kuykendahl Park-and-Ride lot, which cost $2.1 million to construct, was funded entirely by METRO.[1] Construction of the North Shepherd Park-and-Ride lot cost $2.16 million, 70 percent of which was provided through Federal Aid Urban Systems funding and the remaining 30 percent by the State Department of Highways and Public Transportation.

By the end of the 18-month demonstration period, operating costs for the contraflow lane averaged $50,200 per month (or $602,400 on an annual basis). The SMD grant covered about half of contraflow lane operating costs during the demonstration period, after which METRO absorbed all operating costs. The costs to METRO of providing contracted bus service had reached about $4.1 million annually by the end of the demonstration period.

Because access to the contraflow lane was limited to one entrance and exit point, the primary beneficiaries of contraflow operation (and the supporting corridor improvements as well) were suburban residents working in or near the Central Business District who either rode a bus or vanpooled to work. This group had a relatively high average income (i.e., $38,000 versus about $21,000 for the entire Houston region) and was not characterized as transit dependent. The primary benefit afforded to bus riders and vanpoolers was the decrease in travel time which, during the peak hour, amounted to a 40-minute savings on a round-trip basis. In addition, since travel in the contraflow lane was essentially free flow and not subjected to day-to-day variations in congestion levels, it is likely that reliability was also improved. Further, since additional buses were added to routes on an "as needed" basis in response to increased demand, bus riders experienced substantial increases in service frequency over the course of the demonstration.

[1]Since the effectiveness of the contraflow lane was dependent on other supporting corridor improvements, the discussion of costs and benefits is oriented towards these improvements taken as a whole.

In addition to those travellers using the contraflow lane, other peak-direction travellers in non-priority lanes also benefited initially from contraflow operation since congestion eased somewhat as a result of mode shifts to bus and vanpool. Over time growth in the corridor eventually led to a return of congestion levels existing prior to contraflow operation. However, without contraflow operation, it is quite likely that travel conditions on the North Freeway would have deteriorated to an even lower level.

One group adversely affected by the demonstration project were those travelling in the off-peak direction during the hours of contraflow operation. When the contraflow lane was initially proposed (1975), off-peak direction traffic volumes were sufficiently low to insure that adverse impacts would be minimal. When contraflow operation was actually implemented in 1979, though, off-peak direction traffic during the peak period had increased, primarily as a result of the increasing number of firms locating in suburban areas which has led to a corresponding increase in the amount of "reverse commuting" on the North Freeway.

Initially, average off-peak direction speeds decreased considerably (from 51 to 39 miles per hour during the afternoon peak hour) when contraflow operations began. By means of various ramp control measures implemented by SDHPT, average off-peak freeway speeds rose to 45 miles per hour. For off-peak direction travellers able to use the freeway, then, the increase in travel time was minimal. However, those affected by ramp closures also experience an additional delay resulting from diversion to the frontage road.

One potential equity-related issue associated with the contraflow lane is METRO's use of revenues obtained on a regional basis (from both sales tax and fares) to subsidize relatively high quality service to a fairly narrowly defined population group characterized by relatively high income and auto ownership levels. However, if one compares the ratio of fare revenues divided by the cost of providing service on the contraflow lane (.374 for the contracted buses and operational costs associated with contraflow lane) with the corresponding systemwide figure for 1981 (.249), it would appear that contraflow service is one of METRO's better routes from a financial perspective.

TRANSFERABILITY OF RESULTS

In assessing these results in the context of their transferability to potential contraflow projects in other urban areas, a number of factors related to the specific characteristics of the North Freeway contraflow lane and the Houston region in general should be considered. These include:

1. design characteristics of the North Freeway;
2. availability of excess capacity in the off-peak direction;
3. severity of peak direction congestion;
4. length and hours of operation of the contraflow lane;
5. type of transportation improvements implemented in conjunction with the contraflow lane;
6. rapid population growth in the Houston area; and
7. the relatively high level of participation in vanpooling among Houston's commuters.

Feasibility

Freeway design is a fundamental consideration in assessing the feasibility of contraflow operation. On the North Freeway, for example, the location of the northern terminus of the contraflow lane was to a large extent determined by the existance of exit/entrance ramps on the left side of the highway. When priority treatment was extended northward in March 1981, it was in the form of a concurrent flow lane. In addition, the existence of a median shoulder also allowed continued operation of the contraflow lane in the event of vehicle breakdowns, accidents, etc.

A second crucial factor related to the feasibility of contraflow operation is the existence of sufficient excess capacity in the off-peak direction. In Houston, traffic conditions were quite favorable at the time contraflow operation was initially considered. However, because of the rapid growth in population, conditions were somewhat marginal (particularly during the afternoon peak period) when the project was actually implemented four years later. In Houston, though, selected ramp closures were used to divert some traffic to frontage roads paralleling the North Freeway, which in effect served to forestall the time when contraflow operation would no longer be feasible. In urban areas experiencing very low growth rates, one would expect that contraflow operation would continue to be feasible over a longer period of time.

Effectiveness

The effectiveness of contraflow operation stems from the travel time savings realized by vehicles using the contraflow lane relative to those on non-priority lanes. The travel time savings associated with the North Freeway contraflow lane was substantial--40 minutes on a round trip basis during the peak hour. This fairly large savings was attributable to the length of the contraflow lane (9.6 miles), the hours of operation (both morning and afternoon peak periods), and the relatively severe congestion existing on the non-priority travel lanes (average peak hour speeds of 29 and 21 miles per hour in the morning and afternoon peak periods, respectively, versus essentially free flow conditions for the contraflow lane). To a large extent the transferability of results associated with effectiveness of the contraflow lane would depend on similar characteristics.

A second consideration related to effectiveness is the rapid population growth in the North Freeway corridor. Specifically, at the time that the travel surveys were administered (December 1980), 22 percent of all North Freeway travellers had moved into the corridor after the contraflow lane was opened. The corresponding proportion for bus riders (47 percent) was more than double that for all North Freeway travellers. In areas with slower growth somewhat lower increases in transit ridership might be expected.

Another consideration is related to the length of the contraflow lane. While the travel time savings associated with the contraflow lane were directly related to its length, because of limited access to the lane, the longer length also limited the number of potential users of the lane. In Houston, this reduced market potential has not been a major factor in limiting the effectiveness of the lane because of the rapid growth occurring in the outlying areas of the North Freeway corridor. In other areas, though, shorter segments of contraflow operation may be more effective in term of utilization.

A final consideration affecting the transferability of those results related to the effectiveness of contraflow operation is the types of supporting improvements that are implemented in conjunction with a contraflow lane. In the North Freeway corridor, for example, if the contraflow lane had been implemented without expanding bus service and providing park-and-ride facilities, there would have been little opportunity for increased bus ridership.

1. INTRODUCTION

1.1 CONTRAFLOW CONCEPT

Over the past decade there has been a shift away from major capital investments in the construction of new transportation systems towards more effective management of existing facilities as a means of increasing capacity in response to increased travel demand. One major element in this program of improved transportation system management has been the use of exclusive lanes reserved for high occupancy vehicles (HOVs) on urban freeways. The basic concept underlying exclusive lane applications is that such projects, by offering a travel time advantage to HOVs, encourage shifts in mode from low occupancy vehicles to those HOVs authorized to use the priority lane, resulting in higher average vehicle occupancies and increased efficiency in terms of freeway operations.

Projects involving exclusive HOV freeway lanes typically are implemented through one of the following actions:

1. Restricting use of an existing concurrent flow lane for HOVs;
2. Construction of a new lane for use by HOVs only; or
3. Contraflow operation in which an existing off-peak direction lane is restricted for use by peak direction HOVs.

The specific configuration of an HOV lane depends on a number of factors, including existing traffic conditions, freeway design, the availability of alternative routes, costs, etc. For example, the use of concurrent flow HOV lanes, while low in cost, can have significant adverse impacts on congestion if implemented on freeways already at or exceeding capacity. While the construction of separate HOV lanes avoids these severe congestion problems, factors related to freeway design or construction costs may preclude this option.

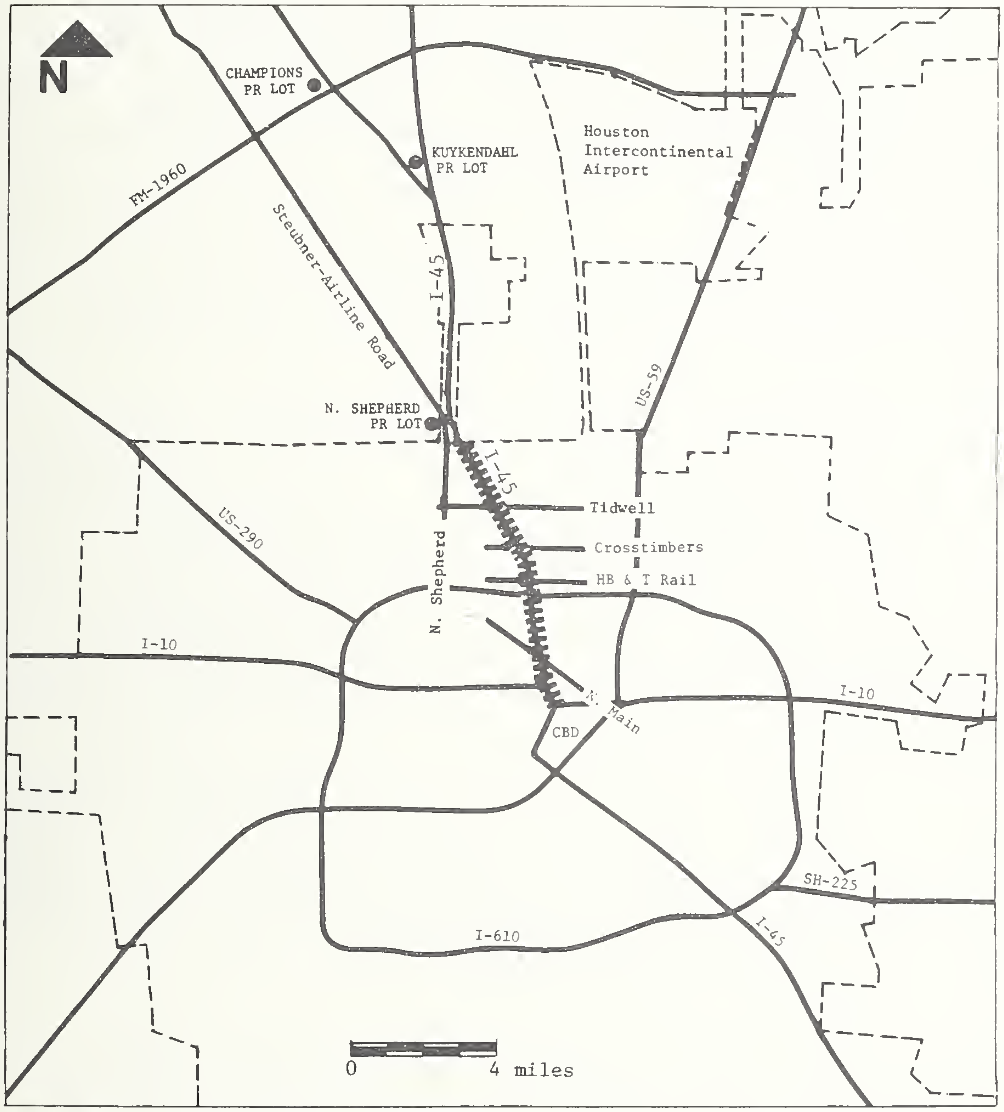
Contraflow operation, which neither adversely impacts peak direction congestion nor requires a major capital investment, may in many situations represent the optimal method for implementing an HOV exclusive lane. The feasibility of contraflow operation depends primarily on the directional split and total traffic volumes on the freeway segment under consideration. In general, if traffic volume in the off-peak direction is at or near capacity, contraflow operation could lead to significantly adverse impacts resulting in congestion for travel in the off-peak direction.

The concept of contraflow operation is by no means new. Excess off-peak direction capacity has been utilized for peak direction travel on bridges and other facilities for a number of years primarily as a means of increasing peak direction capacity without undertaking a major constructon project. In the context of HOV application, though, contraflow operation has additional objectives shared by other types of HOV priority treatment projects. In general, these would include increased average vehicle occupancy, more efficient freeway operation, reduced fuel consumption and vehicle emissions, etc. The extent to which these objectives are achieved depends on traffic conditions existing prior to contraflow operation, specific characteristics of the contraflow lane (i.e., length, classes of vehicles authorized to use the lane, etc.) and the nature of other transportation improvements implemented in conjunction with contraflow operation.

1.2 DEMONSTRATION DESCRIPTION AND OBJECTIVES

In response to rapidly increasing traffic volumes and severe peak period congestion in the North Freeway corridor, the Metropolitan Transit Authority of Harris County (METRO), in cooperation with the Urban Mass Transportation Administration (UMTA), began contraflow operation of the North Freeway on August 28, 1979 as one element of a comprehensive corridor transportation improvement program. In addition to Section 5 Capital Grant Assitance, UMTA's support for the contraflow lane project also included a Section 6 Service and Methods Demonstration (SMD) grant for an 18-month demonstration period.

As shown in Figure 1-1, contraflow operation extended north of downtown Houston to the North Shepherd Drive interchange, a distance of 9.6 miles. The contraflow lane was available for use by authorized buses and



I-45 Contraflow Lane
Park and Ride Lot
----- City Limits

FIGURE 1.1 HOUSTON FREEWAYS AND CONTRAFLOW LANE vanpools travelling inbound on the North Freeway between the hours of 6:00 AM and 8:30 AM and outbound between 4:00 PM and 6:30 PM. However, due to the time needed to set up and take down the contraflow lane (i.e., placing pylons, opening gates, etc.), the number of lanes available for off-peak direction travel was reduced by one from 4:30 to 9:30 in the morning (outbound) and from 2:30 to 7:30 in the afternoon (inbound).[1] The North Freeway contraflow lane had a number of unique features which made it a more ambitious project than other HOV contraflow lane projects. Specifically:

1. at 9.6 miles, it was the longest;
2. it was in operation during both the morning and afternoon peak periods; and
3. it was available for use by authorized vanpools as well as buses.

In addition to the contraflow lane, there were other improvements in transportation services implemented by METRO and the Texas State Department of Highways and Public Transportation (SDHPT) in the North Freeway corridor. These included the construction and operation of suburban park-and-ride lots, the expansion of express bus service to downtown, metering and closing of selected freeway ramps in the peak period,[2] and the expansion of the already established CarShare regional ridesharing brokerage program to include vanpooling. While these associated projects were not funded through UMTA's SMD program, it would be difficult to discuss and analyze the contraflow lane without describing these other improvements and their relative impacts in the North Freeway corridor. As a result, they are referred to where necessary in this report.

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[1]Since the completion of the 18-month demonstration period, the time needed for set-up and take-down operations was reduced by almost half by deploying two crews at different points on the contraflow lane.

[2]This was done to channel off-peak direction traffic down a parallel frontage road for entrance to the freeway downstream of congested sections.

METRO's objectives in implementing both the contraflow lane and associated corridor improvements were to:

1. decrease (or slow the growth of) corridor vehicle miles of travel (VMT) and associated fuel consumption and vehicle emissions;

2. increase vehicle occupancy in the corridor;

3. reduce congestion and, thus, decrease travel time; and

4. encourage acceptance and usage of public transportation.

Specific goals of the UMTA SMD program in funding this contraflow lane project included the following:

1. assess the conditions influencing the feasibility of high-occupancy vehicle contraflow lane operation (e.g., directional split, safety, enforcement, etc.);

2. measure the impacts of HOV contraflow lane operation on mode choice, corridor VMT, freeway congestion, and related travel conditions;

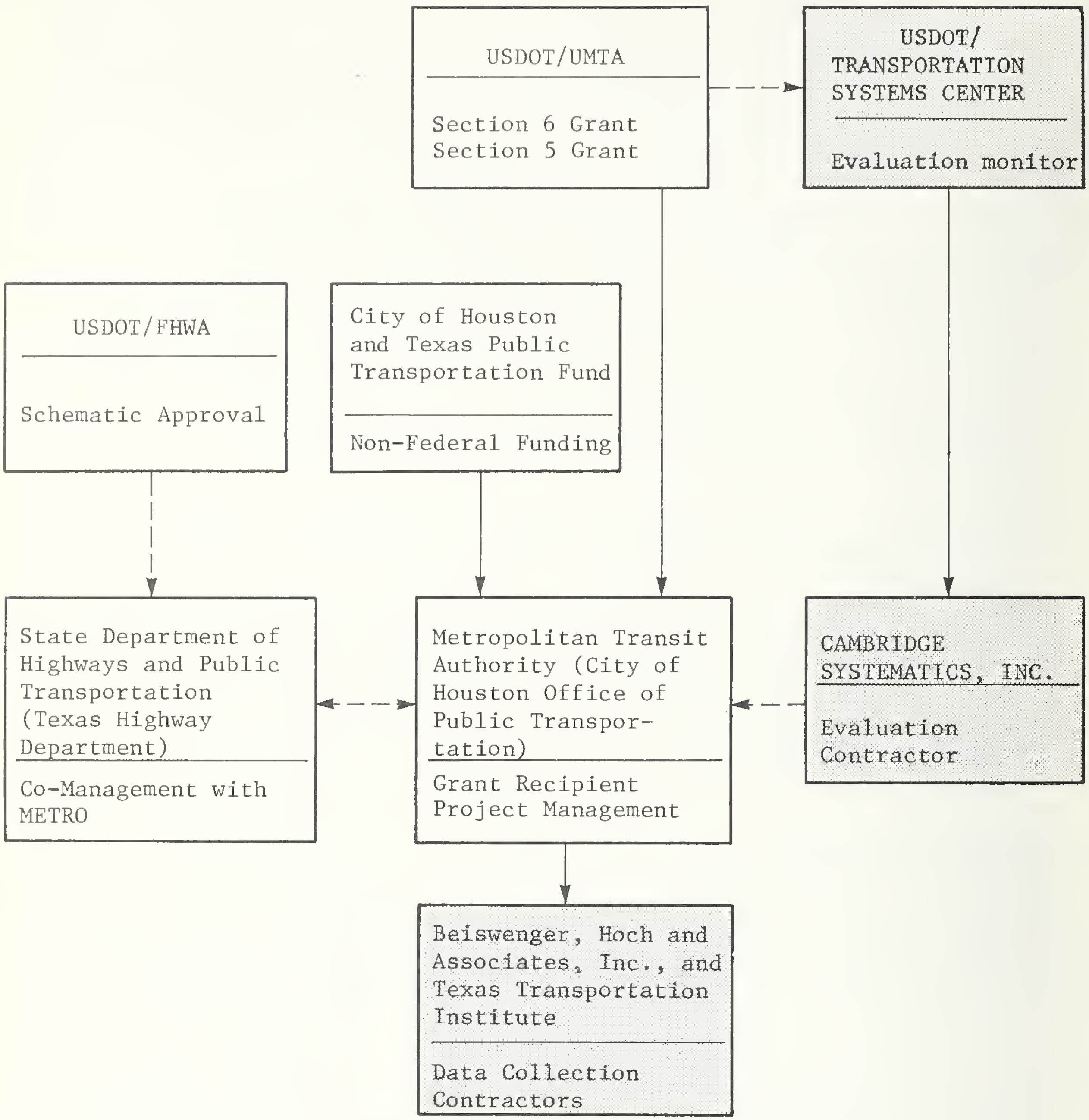
3. investigate the nature of the relationship between the contraflow lane and other corridor improvements; and

4. explore the distribution of costs and benefits associated with contraflow operation.

1.3 ORGANIZATIONAL ROLES

Several agencies were involved in both the planning phase of the demonstration and operation of the contraflow lane after it was opened. Two of these agencies, METRO and SDHPT, underwent organizational transitions between the time of the grant application and the beginning of contraflow operation. These agency transitions, while not having a tremendous impact on the implementation process or schedule, nevertheless complicate the recounting of agency involvement.

Figure 1-2 illustrates the relationships among the various organizations involved in the planning, implementation and operation of the contraflow lane. METRO (and previously, the City Office of Public Transportation) was the UMTA grant recipient and shared management responsibilities for the project with SDHPT. METRO and the SDHPT were the



Note: Shaded boxes indicate participation principally in the project evaluation.

FIGURE 1-2. ORGANIZATIONAL ROLES IN THE IMPLEMENTATION AND OPERATION OF THE CONTRAFLOW LANE DEMONSTRATION authorized representatives, respectively, for the City and State for purposes of enforcing the Contraflow Operations Plan. This plan, which specified details such as operational, maintenance and enforcement procedures and requirements for authorized vehicles and drivers, was the official document governing the operation and management of the lane. This was the first time the State had imposed a restriction on the use of a traffic lane and, although the SDHPT was previously empowered to enforce the restriction, the City was not. On July 25, 1979, the City enacted an ordinance which made the restrictive lane use legal and authorized City police to enforce it.

Within METRO, several departments contributed to the operation of the contraflow lane. METRO's Chief of Project Development in the Department of Transit Systems Development was the contraflow lane manager. The Senior Project Planner in the same division was the assistant contraflow lane manager with responsibility for the day-to-day monitoring and management of the lane, evaluation of project-related impacts, and the dissemination of information to the involved agencies and departments. METRO's CarShare/VanShare office was responsible for both the training and testing of contraflow drivers and for the inspection and registration of vans authorized to use the contraflow lane. The daily operation and supervision of the contraflow lane and inspection of buses was the responsibility of the Operations Department of METRO. Within this department, two 8-person crews, supervised by the contraflow lane supervisor and based at an office near the contraflow lane, performed set-up, take-down, and monitoring functions. One of these crews was responsible for the morning set-up and take-down, while the other handled the afternoon operations. During the contraflow operating periods, the operations supervisor was responsible for assuring the safe use of the lane, keeping a log of the operating status, and recording any incidents (i.e., accidents or vehicle breakdowns).

Funding sources for contraflow lane construction other than UMTA were the City of Houston and the Texas Public Transportation Fund.[1] The Transportation Systems Center (TSC) of the US Department of Transportation was

[1]The Texas Public Transportation fund is state transportation money appropriated and allocated by the State legislature every two years.

responsible for the monitoring and evaluation of this project. Cambridge Systematics, Inc., under contract to TSC, designed the data collection plan and carried out the analyses and evaluation. To assist in the data collection effort, METRO contracted with Beiswenger, Hoch, and Associates, Inc. and the Texas Transportation Institute to administer travel surveys and to collect freeway auto occupancy and park-and-ride lot usage data. The Texas Transportation Institute also played a role earlier in the project as part of the team which examined the feasibility of contraflow operation on the North Freeway.

1.4 EVALUATION DESIGN

The purpose of this evaluation was to document the implementation and operation of the contraflow lane and to assess the extent to which the demonstration achieved the objectives of specific interest to METRO and to UMTA. In making this assessment, the evaluation focused on the following areas:

1. Person and vehicle utilization;
2. Characteristics of users and non-priority travellers;
3. Impact on non-priority users of the freeway;
4. Influence in promoting bus and vanpool use relative to other corridor improvements;
5. Associated safety and enforcement issues;
6. Public acceptance;
7. Impacts on corridor VMT, fuel consumption and vehicle emissions; and
8. Associated costs.

1.4.1 Person and Vehicle Utilization

There were a number of unique aspects of the North Freeway contraflow lane which were of particular interest with respect to utilization. First, because of the relatively long length of the contraflow lane (9.6 miles), its operation during both morning and afternoon peak periods, and the relatively high level of congestion on non-priority lanes, travel time savings for contraflow lane users were expected to be quite large. This would encourage the use of bus and vanpool for peak period travel. On the other hand, because there were no intermediate access points to the contraflow lane, the number of potential users was limited to those with trips originating beyond the contraflow lane entrance (i.e., 10 miles north of downtown Houston) and destinations in or near the Central Business District. One very crucial question to be addressed by the evaluation, then, was the extent to which the contraflow lane was utilized relative to non-priority lanes.

Another characteristic unique to this demonstration was the authorized use of the contraflow lane by vanpools as well as buses. A second question addressed by the evaluation was the extent to which vanpoolers utilized the contraflow lane relative to bus riders. A third area related to utilization addressed by the evaluation was whether or not utilization leveled off after a certain amount of time or continued to grow. This is particularly important in view of the rapid growth in population that was occurring in the Houston region.

The basic approach for assessing contraflow lane utilization was the analysis of average daily peak period vehicle and person counts. These data were available from METRO on a weekly basis during the first 18 months of contraflow operation (September 1979 through February 1981) and on a monthly basis through May 1982.

1.4.2 Characteristics of Users and Non-Priority Travellers

In addition to examining the extent to which the contraflow lane was utilized, the evaluation was also designed to determine who chose to use the contraflow lane and why. This was done by examining the differences between the characteristics of users and non-priority travellers in terms of the types of trips being made and traveller characteristics. Particular attention was given to situational considerations (i.e., residential and employment location, occupation, auto availability, etc.) which could limit the extent to which travellers were able to take advantage of the contraflow lane and other transportation improvements implemented in the North Freeway corridor. This information was obtained by means of travel surveys administered in December 1980 to the following groups of peak period, peak direction North Freeway travellers:

1. bus passengers;
2. vanpool drivers;
3. vanpool passengers
4. auto drivers; and
5. auto passengers

1.4.3 Impact on Non-Priority Freeway Users

While the contraflow lane was expected to result in significant travel time savings for buses and vanpools using the lane, it was also anticipated that non-priority North Freeway travellers would be impacted as well. In particular, increased congestion for off-peak direction travellers was expected since contraflow operation essentially reduced off-peak direction capacity by one lane. For peak-direction non-priority travellers contraflow operation could ease congestion somewhat as a result of mode shifts from auto to bus and vanpool.

These potential impacts on non-priority travellers were assessed by analyzing data from a series of speed runs made by SDHPT. Peak and off-peak direction runs were made in January 1978 and August 1979 prior to contraflow operation, and again in November 1979 after the lane had been in operation for about three months. Additional off-peak direction runs were made in January 1980 after selected entrance ramps had been closed as part of an effort to ease off-peak direction congestion. Travel surveys were also administered to off-peak direction travellers in December 1980.

1.4.4 Influence of Contraflow Lane Relative to Other Corridor Improvements

The contraflow lane was one of several transportation improvements implemented in the North Freeway corridor. Other improvements included significantly expanded bus service and the construction of several major park-and-ride facilities. In addition, METRO began promoting vanpooling through its VanShare office during the demonstration period. One of the objectives of the evaluation was to isolate the impacts of the contraflow lane from these other corridor improvements. In addition, the evaluation sought to determine the extent to which these improvements were mutually supportive.

In the case of transit, the basic approach was to examine ridership trends over the course of the demonstration on those routes existing prior to the implementation of contraflow operation. For vanpool, the growth in vanpooling within the North Freeway corridor was compared with that in the entire Houston region over the same time period. In addition, the perceptions of bus riders and vanpoolers reported in the travel surveys regarding the degree of influence that the contraflow lane had in their decision to travel by bus or vanpool were also examined.

1.4.5 Safety and Enforcement

Under normal freeway operation, vehicles travelling in opposing directions are separated by a median barrier. With contraflow operation, though, opposing traffic is carried on adjacent lanes. One of the prime safety-related concerns associated with contraflow operation, then, is providing an adequate means of lane separation. A more indirect safety impact is related to changes in traffic conditions in the non-priority travel lanes brought about by contraflow operation. For example, to the extent that congestion is increased in the off-peak direction of travel as a result of contraflow operation, one might expect a corresponding increase in accident rates. These safety-related impacts associated with contraflow operation were evaluated using accident report data providing by the City of Houston Police Department.

In many concurrent flow priority treatment projects, particularly those which include carpools, enforcement of lane use restrictions has been a major issue. For the contraflow lane, though, since there was only one entry point (versus almost continuous access for non-separated concurrent flow priority treatment projects) and only buses and vanpools were authorized to use the lane, enforcement was expected to be relatively straightforward. Nonetheless, records of attempted unauthorized lane entry were examined to establish an overall violation rate.

1.4.6 Public Acceptance

To a large extent, public acceptance of a priority treatment project such as the North Freeway contraflow lane depends on the extent and magnitude of adverse impacts on non-priority freeway users. The strong negative reactions from the public and media to concurrent flow priority projects in Boston and Los Angeles, for example, arose primarily in response to the severe impacts on congestion resulting from the restriction of an existing peak-direction travel lane for HOV use. In each of these projects, a relatively large group of people (i.e., peak-direction travellers) were subjected to significantly increased congestion levels. With the North Freeway contraflow lane, though, both the number of people affected (i.e., off-peak direction travellers) and the magnitude of any adverse impacts were expected to be much smaller. As a result, little opposition to the contraflow lane was anticipated. Nonetheless, in view of the strong negative reactions in Boston and Los Angeles, local newspapers were closely monitored for any articles, editorials and letters to the editor regarding the North Freeway contraflow lane.

1.4.7 Vehicle Miles of Travel, Fuel Consumption, and Emissions

Another objective of the evaluation was to assess the extent to which mode shifts from auto to bus and vanpool resulting from contraflow operation would lead to reductions in VMT and associated fuel consumption and vehicle emissions. In view of Houston's rapid growth it was conceivable that any reduction in VMT could be more than offset by increased travel in the North Freeway corridor. In view of this, the approach used to assess the travel related impacts of contraflow operation was to compare VMT and related impacts observed with the contraflow lane in place with what these impacts would have been had the contraflow lane not be implemented. This difference was estimated by calculating the VMT associated with the former modes of bus riders and vanpoolers based on information obtained in the travel surveys administered in December 1980.

1.4.8 Costs

While the capital costs associated with contraflow operation are relatively low, the costs of daily operation of the lane (i.e., setting up and taking down the lane for each peak period) can be quite high. In assessing the feasibility of contraflow operation, the evaluation included a description of the daily operating procedures implemented by METRO and their associated costs.

2. DEMONSTRATION SETTING

2.1 HOUSTON REGION

2.1.1 Population

Houston, the largest city in Texas, is the fastest growing and fifth most populous metropolitan area in the United States. It is located in Harris County, 50 miles from the Gulf of Mexico, in southeastern Texas. In 1970, Houston had an average population density of 3,187 persons per square mile, with a population of 1,233,473[1] located in an area of 387 square miles. In 1980, the population had increased to 1,594,086, implying an average annual growth rate of 2.6 percent for the decade.[2] The city limits had also expanded by 1980 and the new density at that time was 2,952 people per square mile in 540 square miles.[3]

On the average, the population of Harris County grew by 1,300 people every week from April 1970 to April 1980. Approximately 75 percent of these new residents moved to the Houston region from other areas. Many were young, single or recently married and without children. Over 326,000 new households were created between 1970 and 1980. This 60 percent growth rate for households, more than one and one-half times the population growth rate (38 percent), was a result of a decline in average household size from 3.19 in 1970 to 2.76 in 1980.[4]

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[1]1970 US Census of Population and Housing.

[2]Preliminary counts of the 1980 US Census of Population and Housing.

[3]This density is much lower than that for many other large urban areas. For example, the population densities of San Francisco, Chicago, Philadelphia, Pittsburgh, and Boston range from 14,000 to 16,000 people per square mile, while the median for cities over 500,000 population was about 12,000 people per square mile in 1970. However, it is not an unusually low density for Southwestern cities such as Dallas, San Antonio, Albuquerque, Phoenix, and San Diego, which have densities ranging from 2,000 to 3,500 people per square mile.

[4]The Rice Center, "1980 Population and Housing Census Results for Harris County," May 1981.

Houston is in several ways typical of regions experiencing rapid economic development. Table 2-1 shows, for example, that in 1970 the median age in the area was significantly lower than the national mean. Family income in the City approximated the US median, while that of Harris County exceeded the national value. Minorities made up a significant portion of the population: the Houston area had a higher concentration of black residents but a lower concentration of Spanish-surname residents than the rest of Texas.

As shown in Table 2-2, this recent population growth has not been evenly distributed across the Houston region. The area within about six miles from the Central Business District (CBD) lost population between 1970 and 1980, while the ring from 6 miles to 20 miles from the CBD encompassed most of the growth in Harris County. The southwest portion of this 6-to-20 mile ring experienced the largest absolute growth in population (over 200,000 people) while the northwest portion had the largest percentage growth (87 percent).[1] More specifically, the northwest sector (bounded on the east by the North Freeway) developed in the late 1970s and exhibits characteristics of a rapid increase in number of households and a decline in household size. Of the area within Harris County beyond 20 miles from the CBD, the highest population growth occurred in the Northwest, primarily near Highway 6 and FM 1960.[2]

2.1.2 Employment

Houston is a commercial, industrial, transportation, and educational center. The Port of Houston ranks third in the US in terms of export volumes, and the City ranks first as a refinery center. While the port is lined with heavy industrial development, the concentrated CBD, located five miles away (by design), is free of such development and is experiencing a period of substantial growth, including significant highrise construction. The city is

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[1]Because there is only one available entrance to the contraflow lane, people living closer than 10 miles to the CBD cannot take full advantage of the travel time savings of the lane.

[2]FM 1960 at and to the west of the North Freeway is served by two express and one park-and-ride contraflow bus routes.

TABLE 2-1. HOUSTON POPULATION CHARACTERISTICS VERSUS HARRIS COUNTY, TEXAS AND THE US

	City of Houston	Harris County	Texas	United States
Median Family Income	$9,876	$10,348	$8,490	$9,867
Families with Income Below Poverty Level (%)	10.7	9.3	14.6	
Median School Years Completed for Persons 25 Years Old and Over	12.1	12.1	11.6	
Median Age (Years)	26.1	25.8	26.4	28.0
Persons 5-16 Yeras Old (%)	24.6	25.5	24.8	
Persons 65 Years Old and Older (%)	6.4	5.9	8.9	9.8
Black (%)	25.7	20.1	12.5	11.0
Spanish Language or Spanish Surname (%)	12.1	10.7	18.4	

Source: 1970 US Census of Population and Housing

TABLE 2-2. COMPARISON OF 1970 AND 1980 POPULATION CENSUS BY RING, QUANDRANT AND SECTOR OF HARRIS COUNTY

	1970	1980	Percent Change
COUNTY TOTAL:	1,741,912	2,409,544	38.3%
RINGS:			
Near (CBD to 6 miles)	570,394	524,345	-8.0
Mid (6-20 miles)	1,028,430	1,518,752	47.4
Far (20 miles	143,088	366,447	156.1
QUADRANTS:			
Southwest	419,562	627,257	49.5
Northwest	291,003	514,029	76.6
Northeast	377,439	509,567	35.0
Southeast	650,189	756,546	16.4
SECTORS:			
CBD	3,719	2,145	-42.3
Near Southwest	133,806	127,122	-5.0
Near Northwest	104,276	100,260	-3.9
Near Northeast	86,277	74,264	-13.9
Near Southeast	242,316	220,554	-9.0
Mid Southwest	285,577	485,282	70.0
Mid Northwest	166,050	311,177	87.4
Mid Northeast	266,795	356,374	33.6
Mid Southeast	310,008	365,919	18.0
Far Southwest	179	14,853	8197.8
Far Northwest	20,677	102,592	396.2
Far Northeast	24,367	78,929	223.9
Far Southeast	97,865	170,073	73.8

Near = CBD to 6 miles; Mid = 6-20 miles, Far = 20 miles to County line

Source: The Rice Center, "1980 Population and Housing Census Results for Harris County, "May 1981. Compiled from 1970 and 1980 US Censuses of Population and Housing.

largest in the United States without zoning ordinances, which the voters have repeatedly rejected in favor of existing deed restrictions.

The Houston CBD has 170,000 employees, 12 percent of the employment for Harris County.[1] Other major employment/activity centers have developed along principal freeways and arterials. Perhaps most notable is the Greenway-Post Oak area in the Southwest Freeway Corridor. This rapidly growing section of the city is dominated by two major commercial developments, Greenway Plaza and the Galleria, which together employ more than 67,000 people.[2]

The 800-acre Texas Medical Center, located to the southwest of the CBD, encompasses ten major hospitals and clinics, three medical schools, and three research institutes. It employs an estimated 30,000 people and has an average daytime population of 67,000.[3] Fourteen college campuses are located in the Houston area, including the University of Houston, Rice University, and Texas Southern University.

2.1.3 Highway System

The planned freeway system for Houston totals 391 miles and will include a maximum of 12 radial freeways and three concentric rings. As of January 1980, 295.1 miles had been completed and 95.9 were in development.[4] Six major radial freeways presently serve the Houston CBD: the Southwest Freeway (US 59); Katy Freeway (I-10); North Freeway (I-45); Eastex Freeway (US 59); East Freeway (I-10); and the Gulf Freeway (I-45). The three concentric highway rings consist of the elevated system circling the CBD, Interstate Loop 610 (6 miles from the CBD), and the partially completed Beltway 8 (18 miles from the CBD).

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[1] 1980 US Census of Population and Housing, Preliminary Counts.

[2] "The Texas Vanpool Census," Texas Transportation Institute, July 1981.

[3] Rice Center for Community Design and Research, op.cit.

[4] Houston-Galveston Regional Transportation Study Newsletter, January 1980, Vol. 10, No. 1.

Houston also has a comprehensive network of state and farm-to-market highways. The city itself contains 103.8 miles of freeway, 780.1 miles of arterials, and 3535.9 miles of local streets. The Texas State Department of Highways and Public Transportation (SDHPT) has jurisdiction over all expressways and those farm-to-market roads which are state-numbered (only seven of which enter the city). The City of Houston has responsibility and control over all other roads within its limits.[1]

2.1.4 Transit Service in Houston

Public transit began in Houston in 1866 with a mule car operation known as the Houston and Harrisburg Railway Company; streetcar service was introduced eight years later. The conversion from streetcars to buses was completed by 1940. During and shortly after World War II, the bus system (operated by the Houston Electric Company) was greatly expanded, and ridership increased. However, by 1947 ridership began to drop sharply, especially on older routes. By 1960 the company had been sold, refurbished and renamed Rapid Transit Lines (RTL). In 1966, the system was sold to National City Lines, Inc., and service was again expanded. Under National City Lines' management, RTL was at first profitable, but soon suffered increasing losses. In April 1974 the City purchased Rapid Transit Lines for $5.3 million, but retained the National City Management Company to operate the renamed Houston Transit System or "HouTran." In November and December, 1974, HouTran was struck for 6 1/2 weeks by the transit workers union, and significant ridership loss was observed. Another long strike (7 1/2 weeks) occurred in the winter of 1976-77.

In January 1975, the city of Houston's Office of Public Transportation (OPT) was created to plan and implement transit improvements and coordinate public transportation services for the Houston metropolitan area. In 1975, HouTran operation 805.8 route miles of service, with 15,879,433 bus revenue miles and 1,184,747 bus revenue hours per year and an average daily system

[1]Harris County has no authority over roads within the City's corporate limits.

ridership of 105,000. Service hours spanned from 4 AM to 2 AM, but most service was provided between 6 AM and 6 PM. Approxiamtely 341 buses were in operation during the peak period; 173 buses operated in the off-peak on weekdays.

Some of the notable transportation programs and milestones which occurred during the tenure of the OPT were:

1. The CarShare (carpool matching) program was initiated and processed over 10,000 applications in less than two years;

2. The downtown minibus was implemented for a short period and carried 5000 passengers per day;

3. The base fare was reduced (from 45 cents to 40 cents) and the zone system was simplified;

4. Express commuter bus service was initiated;

5. Park-and-Ride service was introduced;

6. Barrier-free transit service was offered for elderly and handicapped residents using specially equipped minibuses.

Despite the City's purchase and operation of transit service and the new programs and projects which were initiated, the public transit system was still not meeting the needs of the region. In the summer of 1978, the people of Harris County were presented with a regional transit plan which assessed public transportation in the Houston area and proposed that a new regional transit authority be established to implement improved service.

> "There is no question but that our current transit system is woefully inadequate. But it is no wonder when you consider the condition of the system which was purchased just four years ago. In 1974, Houston was the last of the major cities in the country to enter the arena of public transit. Our area had already outgrown the transit system. At the time of the City's acquisition, the average age per transit vehicle was 13.5 years and well over 500,000 service miles. Today, even with the arrival of new advanced design buses, more than half the fleet is over 15 years of age.
>
> "We are trying to serve the fastest growing urban area in the country with only 420 vehicles (Los Angeles area is served by over 2,500 buses) which are minimally maintained in a 1910 era trolley car barn desined for 180 coaches....

> "What is needed is a more efficient method, a regional approach to transit. The growing demand for transportation services does not stop at city lines. The entire Harris County area will benefit when we have a truly adequate regional transportation system, with a strong financial base.
>
> "Only with a regional transit system will we begin to meet the challenge of maintaining mobility while accommodating growth."[1]

A referendum on the establishment of a metropolitan transit authority was held on August 12, 1978 and was approved.[2] The Metropolitan Transit Authority of Harris County (known as METRO) officially began operations on January 1, 1979. The jurisdiction of the new authority includes the city of Houston, some enclave incorporated areas, and most of the unincorporated areas of Harris County to the west and north. It excludes most of the county to the east of the city limits (see Figure 2-1). At the time of the transition, the staff and programs of the City of Houston Office of Public Transportation were absorbed intact into the regional organization. Thus, METRO replaced the OPT as the grantee for the North Freeway contraflow lane.

2.2 NORTH FREEWAY CORRIDOR

The North Freeway corridor is an area of diverse land use and activity, with fairly dramatic changes in population characteristics occurring with distance from downtown. For example, residents in the area from the CBD to ten miles north (i.e., people who would generally not be expected to benefit from the contraflow lane) have an average income which is lower than that for

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[1]Metropolitan Transit Authority "Regional Transit Plan," July 1978.

[2]An earlier referendum in 1975 to create a Houston area Rapid Transit Authority funded by an auto emissions tax was defeated.

[3]Fourteen census tracts in the North Freeway corridor closest to downtown were included in a total of 60 Houston census tracts surveyed as part of the 1970 Bureau of the Census Employment Profiles in Selected Low-Income Areas.

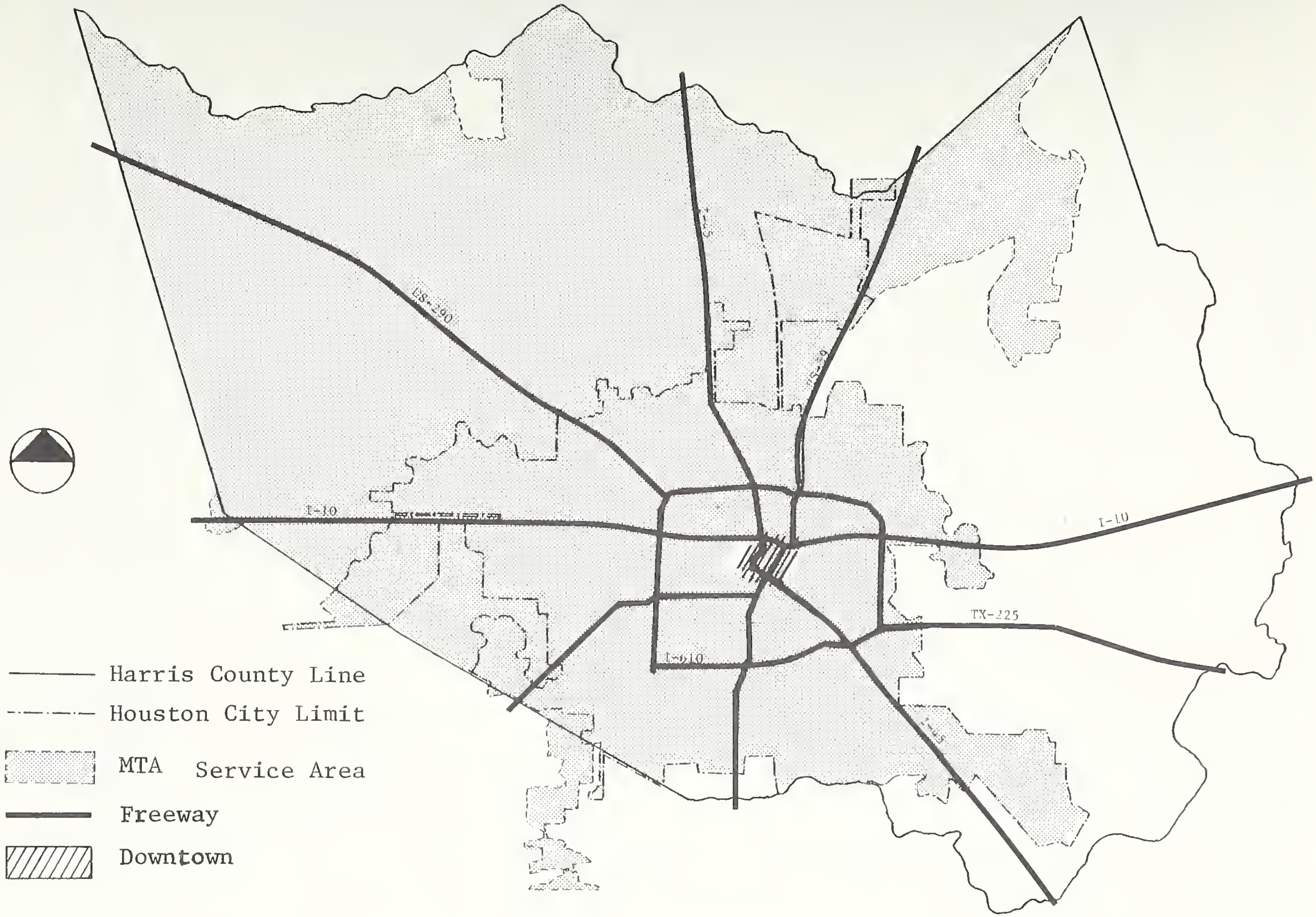

FIGURE 2-1. HARRIS COUNTY AND THE CITY OF HOUSTON

the Houston region.[1] Residents in the corridor north of the ten-mile point, however, have incomes above the median for the city.

The average population density in the corridor (up to about 20 miles from downtown) was 1,420 persons per square mile in 1975. The 1990 projected density is 2,650 persons per square mile, based principally on the expected expansion of housing in the northern part of Harris County and southern Montgomery County. The employment density in the corridor is constantly increasing as more firms locate in the corridor further from downtown.

In addition to other traffic generators, there are three regional shopping centers in the corridor; two are about 5 miles from downtown and the third is 15 miles from downtown. The Houston Intercontinental Airport is also in this corridor, located about 20 miles north of downtown and approximately five miles east of the North Freeway.

2.3 NEED FOR CORRIDOR IMPROVEMENTS

The rapid growth in both population and employment in the Houston region resulted in travel demand which, by the early 1970s, exceeded the capacity of a freeway system planned 20 years earlier. As is typical of recently populated American cities, Houston's development during the age of the automobile fostered low population and activity density. This, together with the availability of parking and the extensive freeway and arterial street system, encouraged reliance on auto travel while it made the provision of transit service expensive due to dispersed origins and destinations.

In response to congested freeway conditions, the City of Houston and other interested governments and organizations[1] began, in the 1970s, to plan improvements for the regional transportation system. In addition to a proposed rapid transit system, many short- and mid-term solutions were proposed for alleviating freeway congestion and reducing regional fuel consumption and vehicle emissions. Corridor improvements were planned for the

[1]The State Department of Highways and Public Transportation, the Houston-Galveston Area Council, the Houston-Galveston Regional Transportation Study, and the Chamber of Commerce.

four most congested radial freeways in the city (i.e., the Katy, Southwest, Gulf, and the North Freeway) with actual implementation occurring first on the North Freeway.

In 1974, when corridor improvements were first proposed, the average weekday traffic on the North Freeway was 122,400 vehicles. The volume increased each year and in 1978 the average weekday use was 134,700 vehicles.[1] In 1975, SDHPT made a special study of peak period traffic volumes at different points on the North Freeway, which indicated that at that point in time morning inbound traffic from North Shepherd to downtown had levels of service of C and D (approaching unstable flow). In the afternoon, outbound traffic in this segment faced a range in level of service from C to E (unstable flow).

To auto drivers, these deteriorating levels of service meant that the average freeway peak hour travel speed of 36 miles per hour in 1969 had decreased to 22 miles per hour by 1976.[2] In the morning, congestion was most severe between 7-8 AM. By 8:15, average speeds were almost up to the legal speed limit. Likewise, the most severe congestion in the afternoon occurred from about 4:45-5:45 PM. At 6 PM (the latest time for which these data were available) the average travel speed had not yet returned to free flow.

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[1]Robert N. Taube and Charles A. Fuhs, I-45 Contraflow Interim Report, Metropolitan Transit Authority of Harris County, Report 80-9, May 1980. Compiled from automatic traffic recorder counts, Station #S-142, at Link Road (South of I-610).

[2]The change in the legal speed limit from 70 mph to 55 mph probably had little or no influence on this.

3. IMPLEMENTATION PROCESS

3.1 HISTORY OF PROJECT PLANNING AND IMPLEMENTATION

The North Freeway contraflow lane was one part of a multifaceted transportation improvement program for which Service and Methods Demonstration (SMD) funding was awarded by the Urban Mass Transportation Administration (UMTA) on June 30, 1975. The original plan, proposed as part of the Houston-Galveston metropolitan area transit improvement program developed in 1974, included corridor improvements on four of Houston's most travelled radial freeways: North Freeway (I-45), Katy Freeway (I-10), Southwest Freeway (US 59), and Gulf Freeway (I-45). The proposed improvements were for some combination of park-and-ride facilities, priority ramp entrances, and contraflow lanes on each freeway. Furthermore, these corridor improvements were designed to be integrated with other transit improvements in the city which were either already implemented or in final planning stages at the time of the grant application.

Originally, the SMD grant award was to cover a 2-year demonstration period. Because of delays in the implementation of corridor improvements, though, the period of the grant was extended. Concurrently, the scope of the grant was reduced as some corridor improvements were indefinitely delayed and/or became too costly to be included within the original level of funding. Finally, the only proposed element to be funded (at least partially) under the SMD grant was the contraflow lane on the North Freeway.[1]

The concept of utilizing the favorable directional split of the North Freeway to implement a relatively inexpensive priority lane for buses was first proposed in 1974 by the Texas Highway Department (THD), shortly after the city had purchased the local bus system.[2] When Houston Mayor Hofheinz committed city resources and support, the THD, in January 1975,

[1]Many of the other radial freeway improvements are still under consideration or have been incorporated into larger, non-SMD-related projects.

[2]The Texas Highway Department was a predecessor of the State Department of Highways and Public Transportation which was established in May 1975.

initiated a study to evaluate the feasibility of contraflow operation of the North Freeway. In April 1975, the City of Houston Office of Public Transportation (OPT) submitted an SMD grant application to UMTA for improvements to four freeways at a total project cost of $1,240,015 (of which $150,902 was for the North Freeway). In June 1975, UMTA approved the grant (TX-06-0018) and designated $861,745 for its share of funding. In September 1975 the Federal Highway Administration (FHWA) granted conceptual approval to the proposed modifications to the freeways, which are interstate highways.

An agreement between the City and the State Department of Highways and Public Transportation (SDHPT) was signed in December 1975 to make a more detailed feasibility study of contraflow operation of the North Freeway and to begin work on design and engineering plans. While this study reconfirmed the feasibility of a contraflow lane on the North Freeway, a major conclusion of the report was a revised (higher) estimate of project costs. The SDHPT, responsible for preparing the detailed engineering plans and construction specifications, notified the City in January 1977 of the need for new lighting and for an additional $50,000 of engineering work, bringing the cost estimate up to $1,184,500. In July of that year, the cost estimate was again revised upward to $1,800,000. In June 1977, the City applied to UMTA for Section 5 Capital Grant Assistance. In September, there was favorable community reaction at a public hearing held to review the contraflow lane plans, and in November, Section 5 funds (Grant TX-05-0026) were awarded by UMTA. In August 1978, in response to a request by OPT, UMTA increased SMD funding from $861,745 to $1,314,700.

In November 1977, SDHPT let bids for a construction contract which was based on both the operations plan agreement signed in 1976 by the City and SDHPT and on the final design specifications approved by both FHWA and UMTA. Construction of the contraflow lane (under the supervision of SDHPT) began in February 1978 and was scheduled to be completed within four months. Due to delays, though, construction of the lane was not completed until January 1979, which coincided with the formation of the Metropolitan Transit Authority of Harris County (METRO).[1] Opening of the contraflow lane was further delayed

[1]METRO replaced OPT as the SMD grantee upon assuming the responsibility of providing transit service in the region.

until August 28, 1979 in order to complete final tasks on the contraflow lane (i.e., installing signs and signals), hire and train an operations crew, arrange for contracts with private bus operators, order the special trucks required for pylon placement, initiate contraflow driver and vehicle certification procedures, and locate temporary park-and-ride facilities.

3.2 COSTS AND FINANCING

3.2.1 Costs

The capital costs of improvements in the North Freeway corridor and the funding sources for each are listed in Table 3-1. Note that in the North Freeway, SMD funds were used only for contraflow lane construction and amounted to about one-fourth of the contribution of UMTA Section 5 Capital Grant Assistance. In total, federal funds accounted for 92.7 percent of the capital costs associated with the contraflow lane. Ramp metering construction on the North Freeway was implemented as part of a region-wide plan for freeway ramp controls. SDHPT had primary responsibility for this element and contributed 30 percent of the capital costs.

The North Shepherd Park-and-Ride lot (which was planned for in the original grant application) was financed through Federal Aid-Urban Systems funds, with SDHPT contributing 30 percent of the costs as a local match. The Kuykendahl Park-and-Ride Lot was financed completely with local funds. Planning for this lot did not begin until the spring of 1978 and, although planning and design for the North Shepherd Lot began in 1975, the Kuykendahl lot was operational three months earlier. The use of non-federal money for both this lot and to make freeway modifications for the concurrent flow lane improvements was a continuation of a recent trend at METRO to rely increasingly on the use of local funds, which serves as an indication of the relative health of METRO's financial base--a 1 percent sales tax.

At the end of one year, contraflow operating costs were $90,052 for professional management and $715,039 for daily operation, supervision, and enforcement. SMD funding covered about half of these operating costs over an 18-month period. The total amount paid to contract bus companies over the

TABLE 3-1. CAPITAL COSTS FOR NORTH FREEWAY CORRIDOR IMPROVEMENTS

	Funding	Costs
Contraflow Lane Construction		$2,176,000
UMTA SMD	$ 408,000	
UMTA Section 5	1,608,000	
City of Houston	60,000	
Texas Public Transportation Fund	100,000	
Ramp Metering Construction		396,000
Federal Aid Interstate	$277,000	
SDHPT	119,000	
North Shepherd Park and Ride Lot		2,160,000
FAUS (FHWA)	$1,512,000	
SDHPT	648,000	
Kuykendahl Park and Ride Lot		2,100,000
METRO	$2,100,000	
Concurrent Flow Lane Construction		138,000
SDHPT	$100,000	
METRO	38,000	
TOTAL		$6,970,000

18-month demonstration period was approximately $4,644,000 or an average of $12,900 per day. None of this expense was financed by the SMD grant. METRO plans to begin operating its own buses on the North Freeway when the existing contracts for contraflow buses expire in late 1982.

3.2.2 SMD Grant Funding

While UMTA typically funds 80 percent of SMD projects, due to the nature of this project and its complex evolution, the SMD grant actually paid for approximately 18 percent of construction costs and 50 percent of the first 18 months of operating costs. The original grant for $861,745 was increased to $1,314,700 in August 1978 in order to expedite the contraflow lane implementation and operation. The allocation of the grant money between the construction and operating period is shown in Table 3-2. Note that approximately $183,000 was designated for non-contraflow purposes and, at the end of the contraflow lane operating period, was still unspent. The use of this money for bus pre-emptive signals and Katy Freeway Corridor improvements is a result of the designation in the original SMD grant application of improvement plans for four corridors.

3.3 PROMOTION AND MARKETING

Promotion and marketing of the contraflow lane was done both by the regular publicity mechanisms used by METRO to market new bus service (principally schedule distribution in the market area and newspaper advertising) and through activity center and corporate ridesharing coordinators. In addition, there was a considerable amount of advance publicity concerning the contraflow lane (i.e., hearings in support of UMTA Section 5 funding, ground breaking ceremonies for the start of construction, etc.). Prior to the scheduled opening day, METRO distributed the brochure pictured in Figure 3-1 and bus schedules for each contraflow route similar to the one in Figure 3-2. Schedules for these buses were clearly marked as using the contraflow lane. In addition, there were two billboard advertisements along the freeway; one specifically promoted park-and-ride service and the other advertised the contraflow lane in general.

TABLE 3-2. HOUSTON SMD GRANT EXPENDITURES

Contraflow Lane Construction	$ 407,590
Daily Operations	476,955
Subcontracts[1]	115,000
Administration[2]	84,540
Evaluation[3]	32,000
Materials and Equipment	4,637
Contingencies	11,308
Contraflow Subtotal	$1,132,030
Katy and Southwest Freeways Feasibility Reports	15,000
Bus Pre-Emptive Signals Evaluation[4]	7,000
Katy Freeway Frontage Road Improvement Construction[4]	160,670
TOTAL	$1,314,700

[1]Subcontracts include marketing costs, feasibility studies by the SDHPT and $9,950 towards the cost of a film about the contraflow lane.

[2]Administration includes $71,332 for professional management, $8,967 for travel and transportation, $3,064 for clerical labor and $1,177 for general administrative costs.

[3]Evaluation includes $29,978 for METRO's data collection contractors.

[4]These expenses were not incurred as of August 1981.

WHEN DOES CONTRAFLOW OPERATE?

Houston's North Freeway Contraflow Lane is open to authorized vehicles:

Monday through Friday
6:00 a.m. - 8:30 a.m.
4:00 p.m. - 6:30 p.m.

HOW IS CONTRAFLOW ENFORCED?

The strict regulations of the Contraflow operation will be enforced by METRO supervisors and Houston Police Officers who will patrol the Lane.

NEW METRO SERVICE

New METRO routes and services have been designed to provide convenient commuter transit via the Contraflow Lane.

PARK & RIDE

Park & Ride service is available *immediately* from donated spaces at:

- Greenspoint Mall, a temporary facility until the holiday season
- Bammel Road Church of Christ, 2700 West FM 1960

Two Park & Ride facilities are scheduled to open later this Fall and Winter:

- North Shepherd at Stuebner-Airline
- I-45 at Kuykendahl

Some Park & Ride services which operate on the North Freeway via the Contraflow Lane provide the first express service from North Harris County through downtown to

- Greenway Plaza
- Post Oak/Galleria

You may obtain specific route and schedule information by calling the METRO Information Center at 651-1212

This project has been made possible through funding by the U.S. Department of Transportation and the Texas State Department of Highways and Public Transportation.

METRO

Metropolitan Transit Authority
401 Louisiana, Houston, Texas

NORTH FREEWAY CONTRAFLOW LANE

FIGURE 3-1. BROCHURE USED TO PUBLICIZE NORTH FREEWAY CONTRAFLOW LANE

NORTH FREEWAY CONTRAFLOW LANE

WHAT IS CONTRAFLOW?

Bright yellow safety posts along the North Freeway I-45 signal the start of a new transit concept being introduced by the Metropolitan Transit Authority. The posts designate the North Freeway Contraflow Lane — an innovative approach to priority treatment for transit.

Contraflow "borrows" an existing lane from the less congested side of the freeway to provide additional capacity for transit during rush hours. Authorized transit vehicles using the Lane travel opposite the general traffic flow, or "Contraflow."

Some 1200 safety posts, placed in pre-drilled holes, 20 to 40 feet apart, separate the Contraflow Lane from adjacent freeway traffic.

The North Freeway Contraflow Lane extends 9.6 miles from the northern edge of downtown Houston and the interchange of I-45 at Stuebner-Airline/Shepherd.

Contraflow has been used since the early 1970's in New York City and on the Golden Gate Bridge in San Francisco.

However, several features of the North Freeway Contraflow Lane make it unique among similar projects in the country:

- Houston's 9.6 mile Contraflow Lane is the longest in the United States.
- Houston's Contraflow Lane is the only operation which operates during *both* morning and afternoon rush hours.
- Houston's Contraflow Lane is the only project in the country with mid-point entrance and exit capability.

HOW DOES CONTRAFLOW WORK?

During morning rush hours, the inside lane on the northbound side of the freeway is used for "Contraflow" — allowing authorized vehicles to travel inbound toward downtown.

In the afternoon, the operation is reversed. The inside lane of the southbound side of the North Freeway is used for "Contraflow."

WHO MAY USE THE CONTRAFLOW?

Only authorized vehicles and drivers certified by METRO are permitted to use the Contraflow Lane.

Authorized vehicles eligible to use the Lane include:

- privately-owned transit coaches contracted by METRO
- airport coaches
- approved intercity suburban buses
- METRO certified Vanpools (12 passenger vans or larger)

All drivers of authorized vehicles *must* —

- have valid chauffeurs' licenses
- carry all required passenger insurance
- successfully complete the METRO Contraflow Driver's Course

Authorized vehicles are marked by Contraflow decals displayed in the front and rear windows.

FOR YOUR SAFETY

In addition to the bright yellow safety posts, other special design features and operational procedures have been developed to insure maximum safety for transit patrons and motorists along the North Freeway.

SET-UP AND TAKE-DOWN

The Contraflow operation crews begin placing the safety posts along the freeway each weekday morning and afternoon 90 minutes before the Lane is opened for authorized vehicles.

- An amber X alerts motorists that the Lane is being prepared for operation . . . drive carefully.
- A red X indicates the Lane is closed.
- A green ↓ indicates that the Lane is open to all motorists.

Gates at the entrance and exit points on the Lane are closed when the Lane is not in operation. The Contraflow is clearly marked by freeway signs and lane designators.

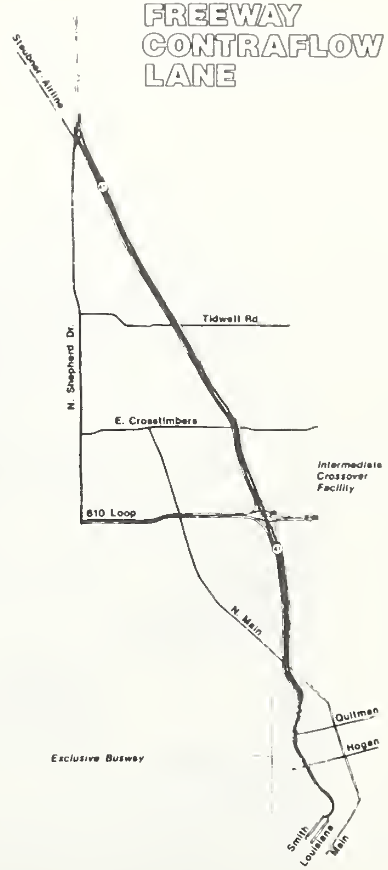
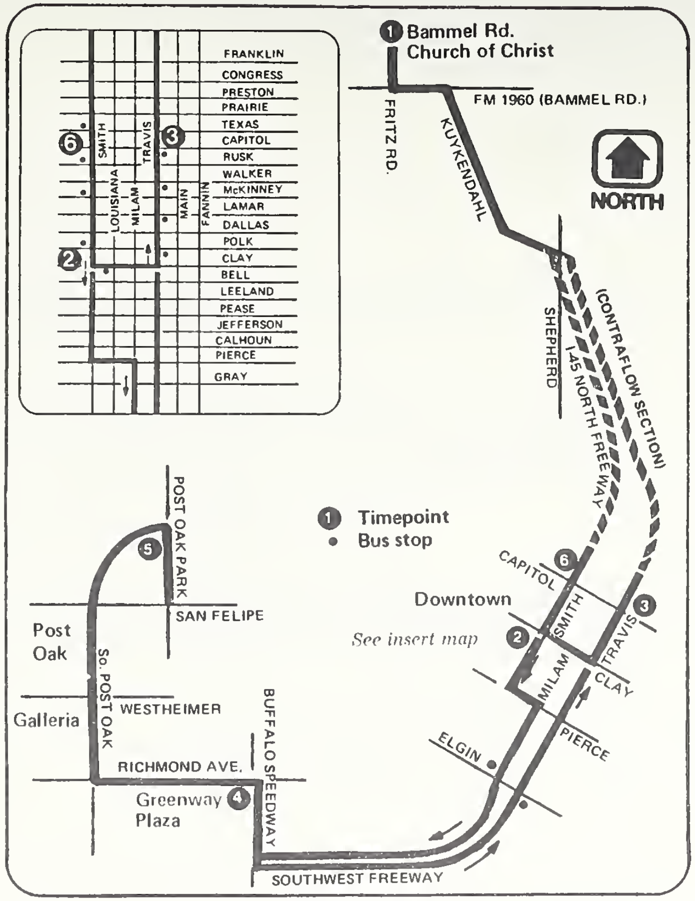


FIGURE 3-1. BROCHURE USED TO PUBLICIZE NORTH FREEWAY CONTRAFLOW LANE (CON'T.)



203 CHAMPIONS

MONDAY THROUGH FRIDAY

INBOUND

CH. OF CHRIST PARK/RIDE LOT 1	SMITH & CLAY 2	TRAVIS & CAPITOL 3	GREENWAY PLAZA EAST 4	SO. POST OAK & POST OAK PARK 5
6:10am	6:42am	6:47am		
6:20	6:52	6:57		
6:30	7:02		7:12am	7:29am
6:40	7:12	7:17		
6:52	7:29		7:40	7:57
7:05	7:42	7:48		
7:15	7:52	7:58		
7:25	8:02	8:08		
7:45	8:22	8:28		
8:13	8:50	8:56		
3:55pm	4:34pm	4:40pm		
4:35	5:14	5:20		
5:01	5:40	5:46		
5:20	5:59	6:05		
5:40	6:19	6:25		

OUTBOUND

SO. POST OAK & POST OAK PARK 5	GREENWAY PLAZA EAST 4	SMITH & CAPITOL 6	TRAVIS & CAPITOL 3	CH. OF CHRIST PARK/RIDE LOT 1
		6:38am	6:47am	7:19am
		6:48	6:57	7:29
		7:08	7:17	7:49
		3:05pm	3:15pm	3:49pm
		3:50	4:00	4:34
		4:09	4:20	4:52
		4:29	4:40	5:12
		4:44	4:55	5:27
4:30pm	4:48pm		5:03	5:35
		4:59	5:10	5:42
		5:09	5:20	5:52
5:00	5:18		5:33	6:05
		5:35	5:46	6:18
		5:54	6:05	6:36
		6:14	6:25	6:55

NO SERVICE operated on Saturday, Sunday or Holidays.

FIGURE 3-2. BUS SCHEDULES DEVELOPED FOR CONTRAFLOW ROUTES

Rider Information

Route 203 - Champions Park & Ride provides you with a convenient and less costly alternative to driving between the FM 1960 - Champions area and downtown. Certain trips also extend beyond downtown to serve the import - ant employment centers of Greenway Plaza, Galleria and City Post Oak. Buses travel non-stop between the Park & Ride lot and downtown, making use of the new Contraflow lane for a saving of 10 - 15 minutes over regular traffic flow. This service is operated under contract to METRO by Oliver Bus Lines, Inc.

The Bammel Road Church of Christ has made these FREE parking spaces avail - able as a public service. Please park in the areas clearly designated by signs for the use of Park & Ride passengers. We suggest car pooling to the lot whenever possible. CARSHARE (another METRO service) will be happy to help. Call 227 - 0003 for further information.

Pay your fare in one of three ways:

COMMUTER CARD – $55 per month for unlimited rides on this and most other METRO routes and services.

SUBURBAN EXPRESS TICKET BOOK – $55 for 40 single ride tickets. Ticket books are valid for a 90 - day period.

SINGLE TRIP TICKET – $1.40 for a one - way ride.

Tickets and passes may be purchased at the METRO Customer Service Center, 403 Louisiana, downtown, between 7:30am and 5pm Monday thruogh Friday. Ticket books, Single trip tickets and passes may also be purchased at Greenwood Pharmacy, 5149 FM 1960 West; Northwest Chamber of Commerce, 3730 FM 1960 West and Century 21 Suburban 1830 FM West.

Other METRO Services

55 - SHOPPER'S SPECIAL . . . A new downtown Houston shuttle service. For only 10¢ a ride (or a valid monthly pass), this route offers frequent trips along Main Street through the central business district from Cullen Center to the County Courthouse and administrative complex. Service operates weekdays every eight minutes between 8am and 4pm. Look for the SPECIAL on the front of the bus and the "10¢" sign in the windshield.

TRANSIT INFORMATION. . . Trained bus information specialists are as close as your telephone 24 hours a day. They would be pleased to answer your questions about fares, schedules and routes and will mail copies of timetables for any METRO service on request. Call 651 - 1212.

park & ride

Champions 203

Route Information and Schedule

Effective April 21, 1980

CONTRAFLOW

METRO

Metropolitan Transit Authority
P.O. Box 61429
Houston, Texas 77208
Genaeral Office & Information Center
401 Louisiana

TRANSIT INFORMATION
651-1212

FIGURE 3-2. BUS SCHEDULES DEVELOPED FOR CONTRAFLOW ROUTES (CON'T.)

Activity center and corporate ridesharing coordinators who were known to METRO's CarShare office were informed of the availability of the contraflow lane for vanpool groups. Companies requesting VanShare assistance after opening day were also informed about the contraflow lane. In addition, the local chapter of the National Association of Vanpool Operators was contacted.

Newspaper articles publicized the beginning of contraflow operation, and the opening day ceremonies received prominent coverage in Houston's two major newspapers. A special bus carried the Mayor, the METRO Board Chairman, a Harris County Judge and other dignitaries on the contraflow lane to downtown.

After the contraflow lane had been operating for about one month, publicity for the contraflow buses consisted primarily of the typical marketing done for any METRO route. When each of the two new corridor park-and-ride lots was opened (i.e., the Kuykendahl and North Shepherd Park-and-Ride lots), new schedules and maps were printed and publicized, and ribbon-cutting ceremonies were held with METRO dignitaries. There was a special celebration on the morning of October 15, 1980 when METRO's executive director presented the one-millionth contraflow bus passenger with a free bus pass for November and one of the pylons used to delineate the contraflow lane. When the concurrent flow extension was opened in March 1981, it was not widely advertised, since only those groups which qualified for use of the contraflow lane could use the concurrent flow lane and priority treatment on the North Freeway had already been well-publicized.

METRO, SDHPT, and the Texas Transportation Institute produced a film about the contraflow lane which summarizes the planning, implementation and day-to-day operation of the project. The film has been shown outside the Houston area to interested professionals and was publicized in national transportation publications as available on loan to any interested organization.[1]

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[1]Inquiries regarding this film should be directed to Mr. Charles A. Fuhs, Metropolitan Transit Authority, P. O. Box 61429, Houston, Texas 77028.

3.4 PUBLIC ACCEPTANCE

In light of the suspension of priority treatment on both the Santa Monica Freeway in Los Angeles (1976) and the Southeast Expressway in Boston (1977) due, in large part, to public opposition, it was important to examine the extent and effect of public opinion both for and against the North Freeway contraflow lane. In general, there was no broad-based opposition to the project; what opposition did exist was isolated and unorganized. The few negative letters to the editors of the major Houston newspapers which were printed (see Appendix C) were responded to by adamant supporters of the contraflow lane.

Newspaper editorials prior to the opening of the contraflow lane were generally supportive of the concept. On June 2, 1980, however, an editorial in the Houston Chronicle asked METRO not to continue with plans for extending the contraflow lane north an additional three miles. The principal reason given was the relatively high level of congestion already faced by afternoon off-peak direction travellers on the North Freeway. METRO, however, had not planned to extend priority treatment in the afternoon, but instead was considering a concurrent flow extension (in the median breakdown shoulder) of priority treatment during the morning period. The Chronicle, once advised of METRO's actual plans, had no further negative editorials.

An important distinction between this project and those in Los Angeles and Boston is that by taking a lane from the off-peak direction traffic (instead of the peak direction), the North Freeway contraflow lane had a much smaller negative impact on freeway users in terms of both the number of people affected and the magnitude of the impact. In addition to being few in numbers, the impacted group ("reverse" or crosstown commuters) probably did not live or work in sufficiently concentrated areas to become an organized force against the lane. METRO was not insensitive to this group, though, and sought to minimize any adverse impacts of the contraflow lane by means of ramp controls and revised set-up procedures. In addition, METRO and SDHPT continually monitored freeway travel conditions in anticipation of the time when the volume of off-peak direction travellers would render continued operation of the lane infeasible.[1]

3.5 FUTURE PLANS

Since 1980 METRO has been formulating plans for a long-term solution to the capacity and congestion problems on the North Freeway. They intend to continue priority treatment but hope to replace the contraflow lane with a reversible median lane for use by authorized buses and vanpools. As currently planned, the lane would operate southbound from 6-11 AM and northbound from 12-8 PM and is projected by METRO to carry 21,000 passengers daily when it opens. Based on the current schedule, construction of the authorized vehicle lane (AVL) is expected to begin in early 1983. Priority treatment will not be interrupted during construction, and sections of the AVL will be connected to the contraflow lane as they are completed. By the end of 1984, the AVL is expected to extend from downtown Houston to the North Shepherd Drive interchange. At that point work may begin on extending the AVL further north.

On October 28, 1981, the METRO Board of Directors voted to allocate approximately $4 million in local funds for detailed studies and designs for the AVL. Total cost for the AVL portion of the project is estimated at $52 million. The Board also voted to concur with SDHPT's grant applications to UMTA and FHWA for funding assistance for the AVL design and construction.

Other changes planned for the North Freeway Corridor include new and expanded park and ride lots. The North Shepherd lot, with a current capacity 750 vehicles, will be expanded by an additional 650 spaces in 1982. Two new

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[1]The North Freeway directional splits measured in 1975 were 75/25 in the AM and 69/31 in the PM. These had fallen to 71/29 and 61/39, respectively, by August 1979 when the lane first opened. This new directional split only marginally justified contraflow operations in the afternoon. This was not an unexpected situation, though, since in its feasibility analysis report of 1975, the State noted that in addition to a general increase in travel demand on the freeway, the rapid growth of reverse commuting would, at some point, necessitate the discontinuation of the contraflow lane.

lots will be built on FM 1960, one in 1982 and one in 1983. The first of these, at FM 1960 and I45, will have a capacity for 1,300 vehicles and will replace the currently leased Champions lot, which has a capacity of 330. The second will be at FM 1960 and FM 149. All lots are being expanded or developed with local funds from METRO.

4. FREEWAY MODIFICATIONS AND CONTRAFLOW OPERATIONAL PROCEDURES

Implementation of the North Freeway contraflow lane involved a number of freeway modifications and the development of procedures for shifting from normal to contraflow operation during the morning and afternoon peak periods. This chapter first describes the modifications needed to provide access to the contraflow lane from non-priority lanes and to insure adequate lane separation from off-peak direction traffic. Then, contraflow lane operational procedures are discussed, including set-up and take-down procedures, bus and vanpool certification requirements, and enforcement. Following this is a description of the concurrent flow priority lane, which was opened in March 1981. Finally, the costs associated with the construction and operation of the contraflow lane are presented.

4.1 FREEWAY MODIFICATIONS

The North Freeway (I-45) is an interstate highway which was built between 1959 and 1962. It has 12-foot wide travel lanes, 10-foot wide break-down shoulders adjacent to the median and outside lanes, is paralled by a frontage road for more than half of the contraflow segment, and in almost all cases, crosses over intersecting arterial streets. Within the area selected for contraflow treatment, there are no left-hand ramps or other design constraints inhibiting the implementation of a standard contraflow application. The major modifications required for this project, then, were:

1. Construction of special entrance and exit ramps at the northern terminus, the mid-point, and the southern terminus just outside downtown;

2. Provisions for lane separation between contraflow and off-peak direction traffic; and

3. Ramp metering and closings to ease congestion for off-peak direction travel.

4.1.1 Contraflow Lane Access

The northern contraflow terminus (9.6 miles from downtown at North Shepherd Drive) was located at one of the few left-hand entrance ramps on the freeway. The freeway median at that point widens to over 100 feet to accommodate this entrance, which provided an excellent opportunity for an at-grade contraflow entrance for relatively little cost. This general location was also selected as the terminus since, in 1975 when feasibility studies and preliminary engineering were done, it was the northernmost point of recurring congestion on the North Freeway.

In the morning peak period, authorized vehicles could enter the contraflow lane from North Shepherd Drive via a newly constructed buttonhook ramp or from the regular North Freeway lanes via a median crossover (see Figures 4-1 and 4-2).[1] In the afternoon, contraflow vehicles again had the option of either leaving the reserved lane directly to North Shepherd Drive or of continuing north in the regular freeway lanes (see Figures 4-3 and 4-4).

At the southern terminus (near downtown), the existence of a left-hand exit connecting the North Freeway to I-10 eastbound required special handling of the contraflow exit. In this area, priority treatment became an exclusive reversible lane (in the median) and, eventually, a reversible lane using the roadway shoulder to transfer contraflow vehicles from the freeway area to the downtown street system (see Figures 4-5, 4-6 and 4-7). Gates in this area, as well as the entrances to ramps at the northern terminus were closed and locked during non-operating periods.

Midway along the contraflow segment at the I-610 interchange, there was a crossover in the median which was intended to allow vehicles to enter or exit

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[1]In the spring of 1981 when an AM concurrent flow extension was added to the contraflow lane (see Section 4.4), the location of the contraflow lane entrance from I-45 was moved north about one-half mile. There was still an option to enter the contraflow lane from the freeway or from North Shepherd Drive.

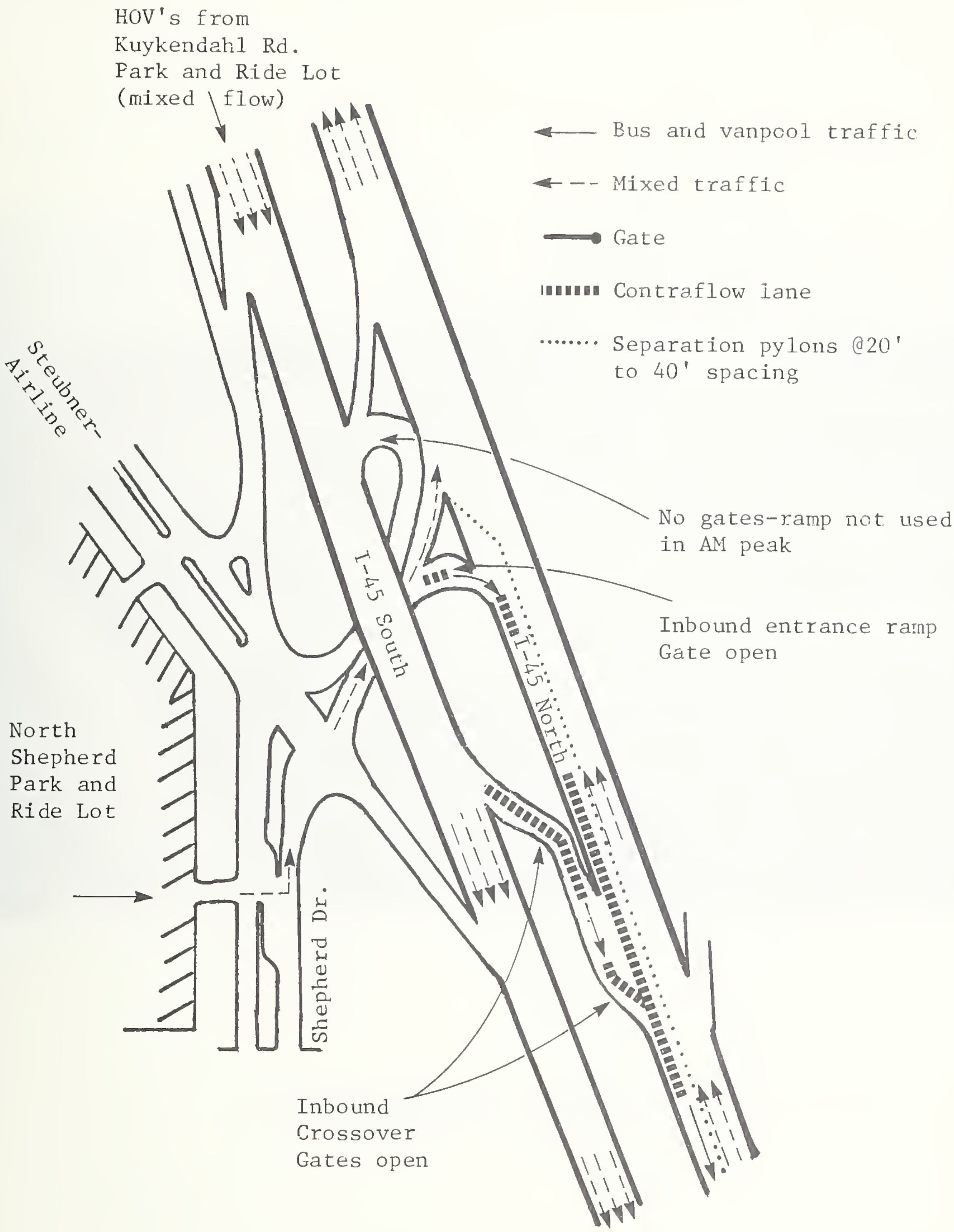

FIGURE 4-1. NORTH TERMINUS OF I-45 CONTRAFLOW LANE: AM PEAK PERIOD OPERATION OF ENTRY/EXIT RAMP AND CROSSOVER

FIGURE 4-2. NORTH TERMINUS OF CONTRAFLOW LANE: AM PEAK OPERATION OF MEDIAN CROSSOVER

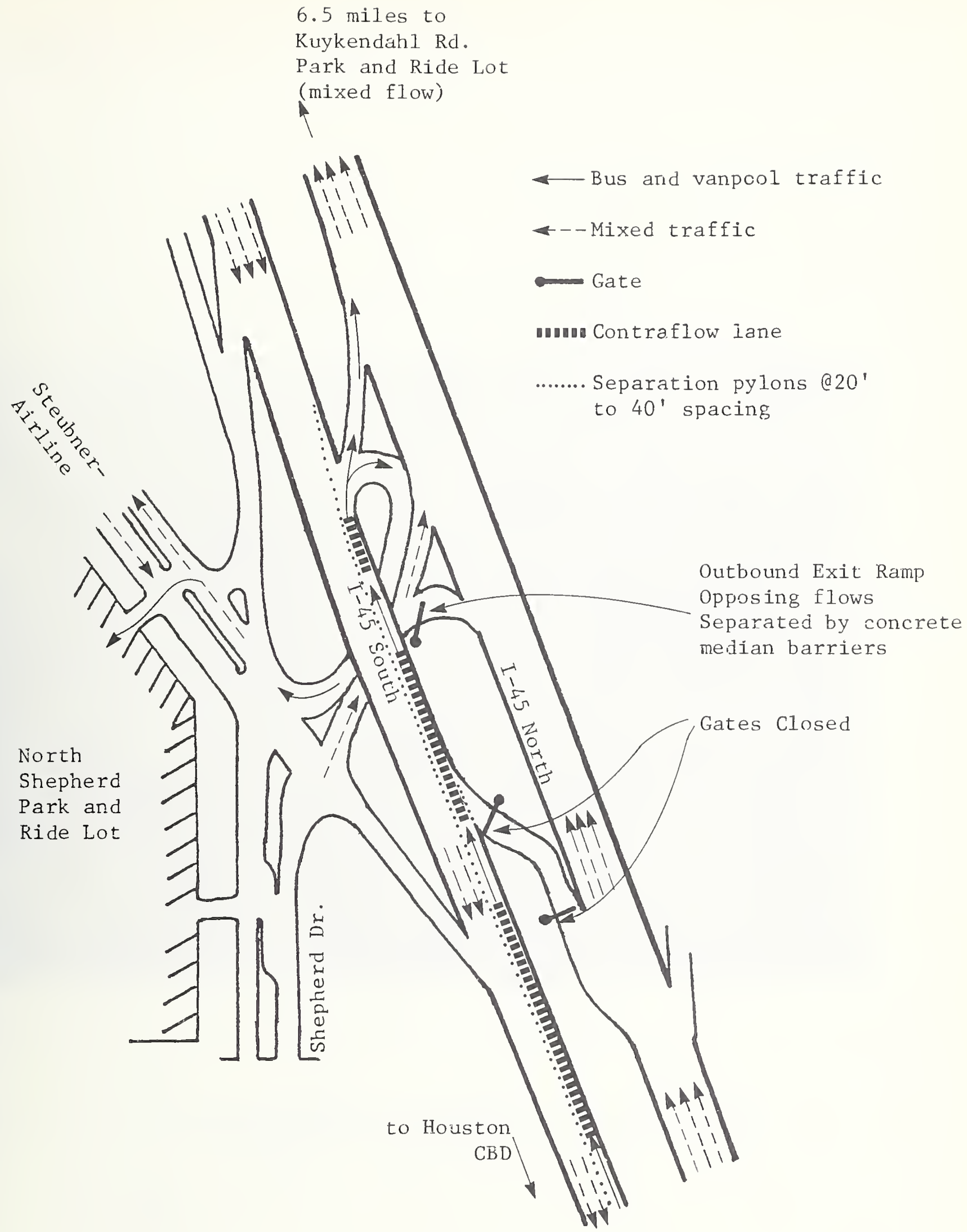

FIGURE 4-3. NORTH TERMINUS OF I-45 CONTRAFLOW LANE: PM PEAK PERIOD OPERATION OF ENTRY/EXIT RAMP AND CROSSOVER

FIGURE 4-4. NORTH TERMINUS OF CONTRAFLOW LANE:
PM OPERATION OF MEDIAN CROSSOVER

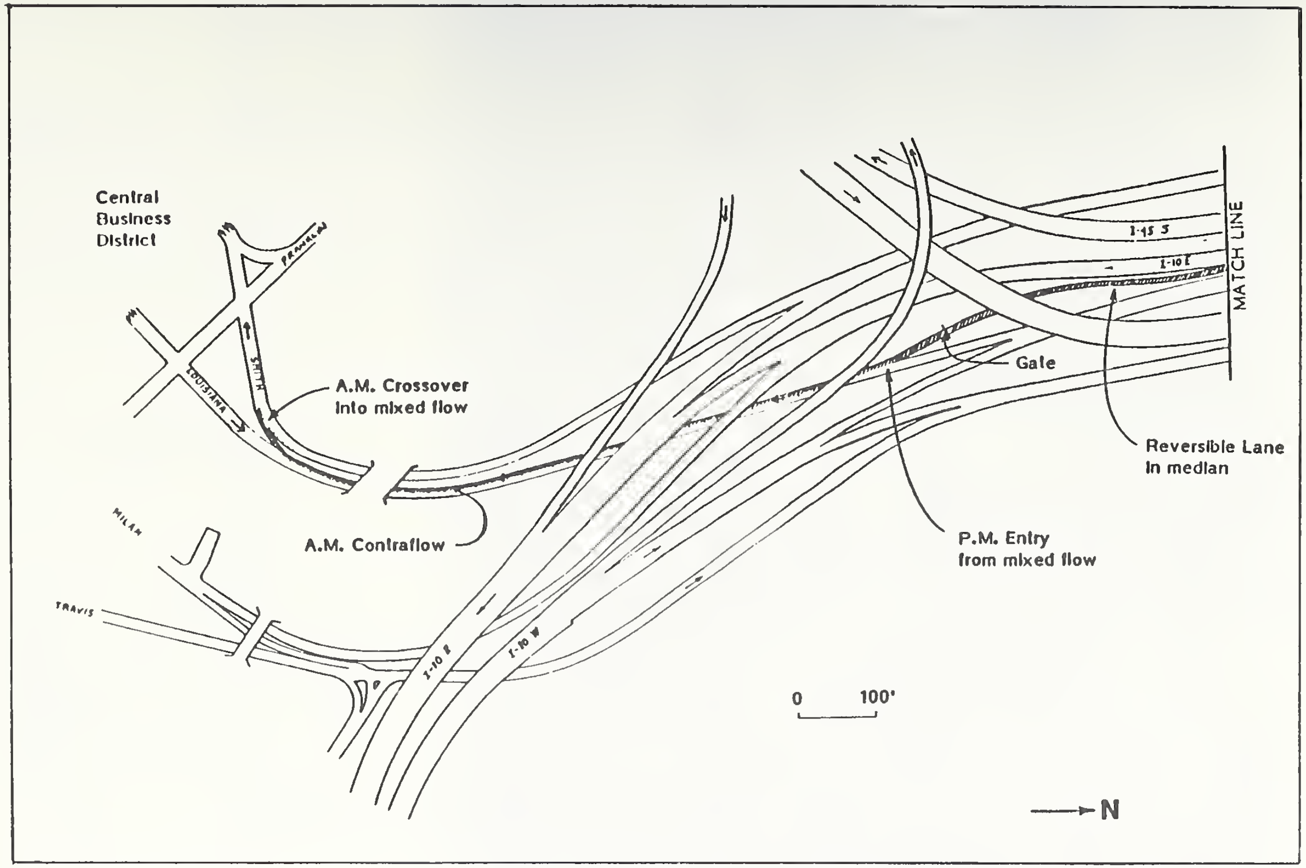

FIGURE 4-5. DOWNTOWN TERMINUS OF CONTRAFLOW LANE

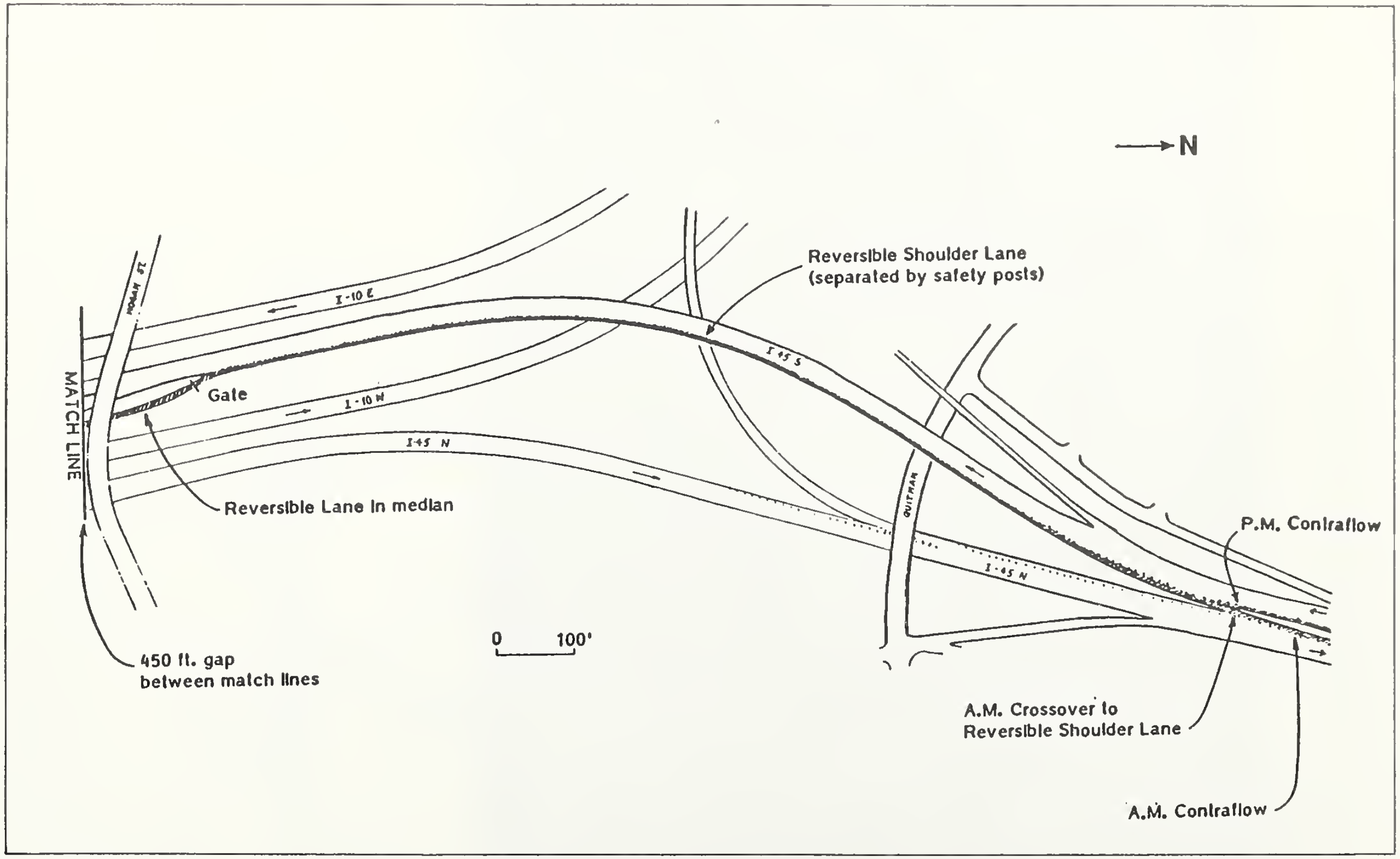

FIGURE 4-5. DOWNTOWN TERMINUS OF CONTRAFLOW LANE (CON'T)

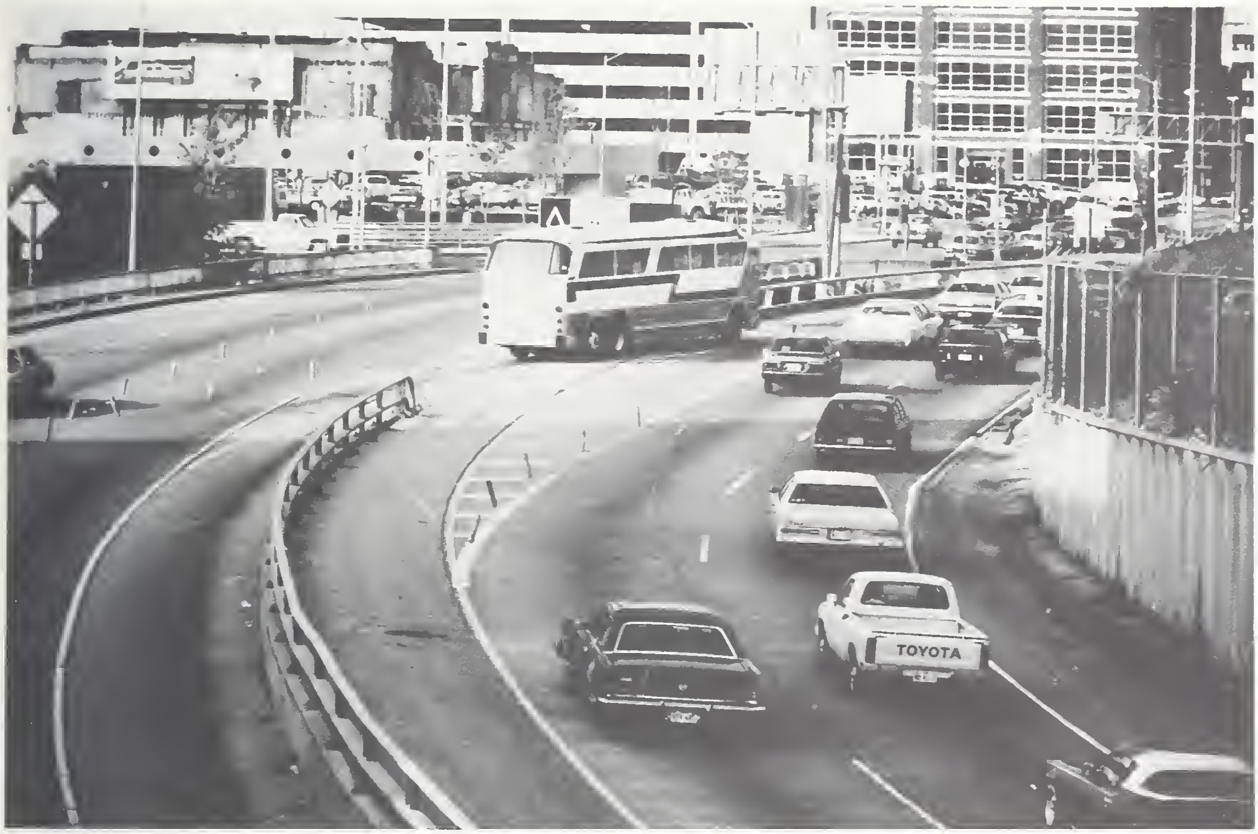

FIGURE 4-6. SOUTH TERMINUS OF CONTRAFLOW LANE (AM OPERATION): MERGE WITH NORMAL TRAFFIC

FIGURE 4-7. SOUTH TERMINUS OF CONTRAFLOW LANE: MEDIAN REVERSIBLE LANE

the contraflow lane to or from the regular freeway lanes in the morning and in the afternoon. To construct this crossover, the median barrier was removed and, essentially, a seventh travel lane was created in the middle of the highway. Concrete barriers with staggered openings separated this crossover from the regular travel lanes (see Figure 4-8). While the original contraflow lane operating plans included unlimited access for authorized vehicles between the regular lanes and the contraflow lane at this point, the midpoint crossover was never opened for general use. The crossover was invaluable, however, for emergency removal of vehicles.

4.1.2 Lane Separation

The primary means of separating the contraflow lane from oncoming off-peak direction traffic were 18-inch lane separation pylons installed and removed during each peak period. These pylons were inserted in holes that had been drilled in the freeway pavement at 20 to 40 foot intervals. These holes were located 12 feet from the median shoulder even in sections where the inside lane was 14 feet wide. Adjacent to the reserved lane was a median emergency shoulder 10 feet in width which was continuous throughout the contraflow segment except at the midpoint crossover and the I-10 interchange downtown.

In addition to the 18-inch separation pylons, there were various other devices along the freeway to inform off-peak direction motorists of oncoming contraflow traffic and restricted lane use. At both ends of the contraflow lane and at the midpoint crossover, for example, there were overhead changeable lane signals which displayed a red "X" when the contraflow lane was in use, a yellow "X" indicating set-up or take-down operations, or a green arrow meaning regular freeway travel was allowed to use the lane (see Figure 4-9). There were also signs spaced along the median with yellow signals which flashed in the off-peak direction during contraflow operating periods to indicate that the contraflow lane was in use. All ramp entrances to the contraflow lane had signs indicating that use was reserved only for authorized vehicles. The diamond shaped reserved-lane symbol was painted on the lane pavement about

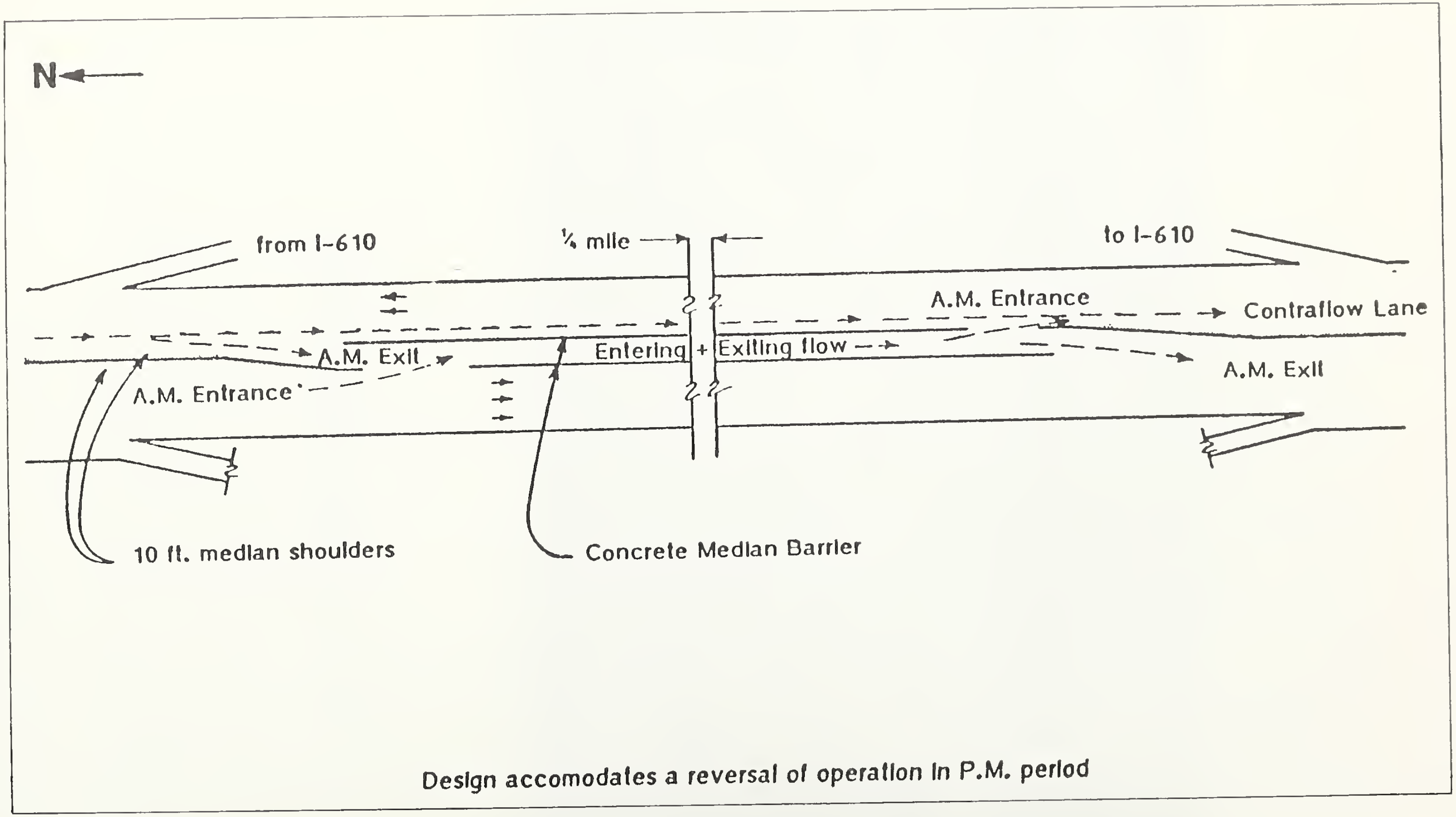

FIGURE 4-8. MIDPOINT CROSSOVER AT I-610

FIGURE 4-9. SEPARATION POSTS AND OVERHEAD LANE SIGNALS

500 feet and appeared on all the signs referring to contraflow use. Changeable signs at the entrance to the lane indicated to bus and van drivers whether the lane was open or not so that an alternate route could be chosen before approaching the freeway on the contraflow ramps (see Figure 4-10).[1]

4.1.3 Ramp Control

Selected ramp metering and closure for the North Freeway was part of a metropolitan area-wide program of freeway ramp control. Originally, plans for I-45 included modifications for peak direction ramp entrances only. However, with the introduction of contraflow priority treatment, North Freeway ramp control was expanded to include off-peak direction ramps as well. It was hoped that ramp closure for afternoon, southbound travel would help ease any congestion created by the loss of one lane to contraflow traffic.[2]

Ramp metering (peak direction only) was implemented in March 1979, prior to the beginning of contraflow operation. Additional ramp closures were begun on an experimental basis on January 3, 1980. Initially, wooden barricades and cones were used. These were later replaced with gates (see Figure 4-11). Vehicles prevented from using certain ramps were diverted to a parallel frontage road for entrance to the freeway downstream of congested segments. It was felt that minor amounts of diversion could significantly improve freeway travel speeds, and there was sufficient extra capacity on the frontage roads to handle the diverted traffic. In addition, minor adjustments in traffic signal cycles at intersections between the frontage road and arterial cross streets

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[1]Although the scheduled opening time in the afternoon was 4:00, if the lane was ready, it could have been opened up to 15 minutes earlier. Conversely, a delay in lane set-up or problem such as an accident or freeway flooding could cause the lane to remain closed during the regular operating period.

[2]Ramps were not closed for morning, northbound travel since AM off-peak direction travel speed and level of service were not significantly affected by contraflow operation.

FIGURE 4-10. CONTRAFLOW LANE ENTRANCE SIGNS

FIGURE 4-11. OFF-PEAK DIRECTION RAMP CLOSURE

were made to favor frontage road vehicles, thereby giving the best level of service possible for the diversion route.[1]

4.2 CONTRAFLOW LANE OPERATIONS

4.2.1 Set-Up and Take-Down Procedures

The contraflow lane set-up and take-down procedures were handled by a METRO crew of eight people in four trucks. In addition, two police cruisers under contract to METRO travelled with the METRO trucks (one in front and one at the rear) to give visibility to the group. To minimize the impact on off-peak direction traffic and to assure the safety of the operations crew, the contraflow set-up was done with the flow of traffic, building the lane behind the platoon of METRO vehicles (see Figure 4-12). The take-down was done in the contraflow direction, thereby opening the lane to regular traffic behind the METRO vehicles (see Figure 4-13).

The first of the METRO vehicles in the platoon was the wrecker which removed any stalled vehicles. Following the wrecker were two specially designed stake-bed trucks in which the 1200 separation pylons were stored. Three people were needed for each of these trucks: one to drive, one to distribute (during set-up) or restack (during take-down) pylons, and one (sitting in a pit between the truck axles) to place or remove the pylons from the pre-drilled holes in the pavement (see Figure 4-14). Two trucks were necessary both to maintain a reasonable travel speed (about nine miles per hour) while every other pylon was removed or placed and to have sufficient storage space for all the pylons.

The last METRO truck, driven by the crew leader, transported an air compressor used to clean clogged holes. The crew leader was responsible for

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[1]Traffic volumes on the intersecting arterials was low enough so that these signal adjustments did not significantly increase delays for those travellers.

FIGURE 4-12. CONTRAFLOW LANE SET-UP

FIGURE 4-13. CONTRAFLOW LANE TAKE-DOWN

FIGURE 4-14. INSTALLATION OF SEPARTION POSTS

correcting any problems in pylon placement or removal and for activating flashers and lane controls at 14 locations along the lane. When the pylon placement was completed and the wrecker had made one last sweep of the lane, the crew leader would change the lane status signs and open the entry gates.

During operating periods, some members of the set-up crew were stationed near the exclusive lane section just north of downtown to monitor operations and record vehicle usage data on log sheets. The contraflow wrecker was stationed at either the entrance to the contraflow lane or the midpoint crossover during operating periods and, through radio contact, was available to respond to an emergency at any point on the lane.

In June 1981, the set-up operation was modified so that the two stake-bed trucks carrying the separation pylons started at different points on the lane instead of travelling in one platoon. When this change was made, the time required for set-up in the afternoon was reduced from 75 minutes to about 45 minutes, and the average time required to take-down the lane for both periods was reduced from about one hour to 35 minutes. (Set-up procedures for the morning period were never changed, since at 4:30 AM, when set-up operation began, freeway capacity was sufficiently underutilized so that the removal of a lane presented no problems.) Implementing this change was considered as early as the summer of 1980. However, the necessity of some minor construction and in- stallation of warning signs and signals (to indicate intermediate closure of the left-hand lane) delayed implementation for about a year.

4.2.2 Bus and Vanpool Certification Requirements

To ensure the safety of lane users and freeway auto drivers, strict requirements for both contraflow vehicle authorization and driver certification were adopted by METRO. Every vehicle using the lane was required to display a METRO-issued contraflow lane authorization decal, and every person driving on the lane had to have in his or her possession a valid contraflow driver identification card.

Vehicles eligible for contraflow authorization were:

1. official METRO transit vehicles;

2. buses operated under contract to METRO;

3. other full-sized transit vehicles used for regularly scheduled service (principally intercity and airport service); and

4. passenger vans designed to carry eight or more people including the driver.[1]

For all except official METRO vehicles, the following requirements had to be met in order to be granted authorization to use the lane:

1. For vanpools, a minimum of eight people including the driver had to be registered. The driver was required to keep a ridership log which was subject to inspection by METRO.

2. Proof of current, valid vehicle liability insurance had to be furnished to METRO. Acceptable minimum coverage was:
   a. $250,000 per person for bodily injury;
   b. $500,000 per occurrence for bodily injury;
   c. $100,000 for property damage.

3. Vehicles had to have a valid State of Texas inspection sticker.

4. Vehicles had to pass a METRO vehicle inspection and display contraflow decals on front and back windshields.

5. Vehicles could be driven on the contraflow lane only by a certified contraflow driver.

To become certified and to operate a vehicle on the contraflow lane, drivers were required to:

1. have a State of Texas chauffers license;

2. have a good driving record (no more than two moving violations within the past year) and be in good physical condition;

3. complete the METRO contraflow drivers training course including passing a written test;

4. possess their contraflow driver identification card while driving on the lane;

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[1]In August 1979 when the contraflow lane opened, the requirement for vans was that they be able to seat a minimum of 12 people including the driver. This was modified to eight in April 1980.

5. abide by all rules and regulations regarding use of the contraflow lane; and

6. assume responsibility for moving their vehicle to a place of safety should it breakdown on the contraflow lane.

4.2.3 Enforcement

These regulations were enforced by both lane entrance surveillance and spot checks of vehicle condition and driver possession of a contraflow driver identification card. Lane surveillance was done during every contraflow operating period at the lane entrance (see Figure 4-15) and at the midpoint by Houston police in a marked car and by the contraflow lane operations crew who also recorded vehicle and person usage of the lane. While any vehicle attempting to enter the lane which was neither a van nor a bus was obviously in violation of contraflow regulations, any van or bus which did not have contraflow registration decals would also be stopped and turned back.

METRO informed contraflow drivers that spot checks at the contraflow lane entrance would be used to ensure continuing compliance with certification requirements. Spot checks were rarely made (there was only one in the first nine months of contraflow operation) and when they were, very few instances of violations were found.[1]

4.3 CONCURRENT FLOW LANE

The major post-demonstration change to contraflow operation on the North Freeway was the opening of a 3.3 mile concurrent flow lane (morning inbound only) on March 30, 1981. The concurrent flow lane terminated at the contraflow lane entrance at North Shepherd and extended morning priority treatment north to West Road, approximately 13 miles from downtown (see Figure 4-16). The cost to METRO and SDHPT of implementing this corridor improvement element was about $130,000--all from local sources.

When implementation of a contraflow lane was first studied for the North Freeway, the North Shepherd Drive interchange was approximately the northern-

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[1]Typical violations were missing safety gear or failure to have a contraflow driver identification card.

FIGURE 4-15. SURVEILLANCE AT ENTRANCE TO CONTRAFLOW LANE

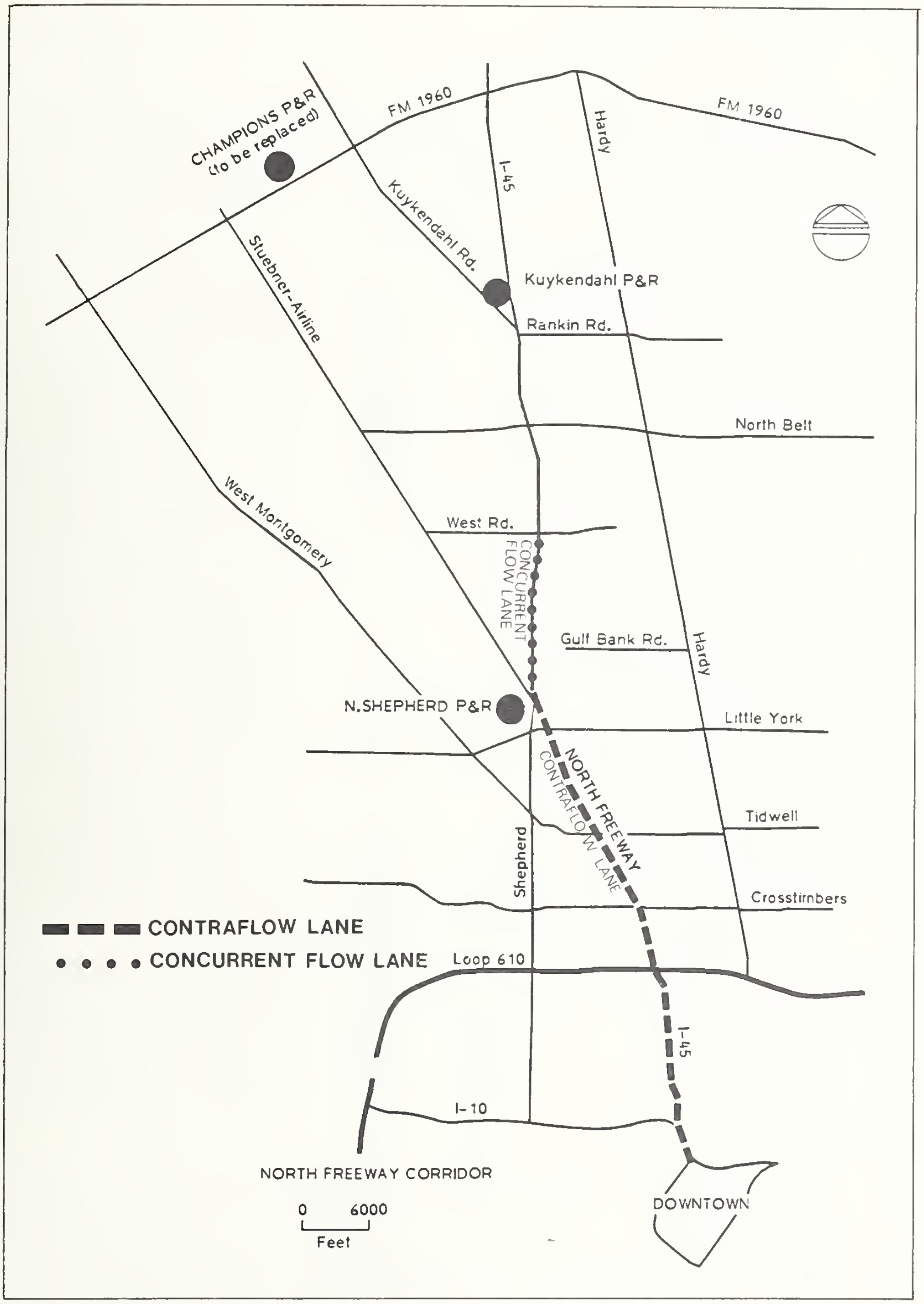

FIGURE 4-16. CONCURRENT FLOW LANE

most point of recurring congestion. In the interim planning and implementation period, congestion worsened so that by the time the contraflow lane opened, buses and vanpools entering the freeway north of North Shepherd experienced congestion and delays in getting to the contraflow lane entrance. Since the design and operational characteristics of the North Freeway did not lend itself to extending the contraflow lane further north of North Shepherd, an alternative means of bypassing the congestion was sought.

Concurrent flow priority treatment was first proposed in early 1980. Congestion in the freeway segment north of North Shepherd was so bad, it was not possible to restrict the use of an existing travel lane for priority vehicles. Thus, the median shoulder, which was found to be sufficiently strong to support projected usage, was designated as a concurrent flow lane. Signs were installed, lanes were restriped to widen the shoulder over bridge decks, and bridge railings were reinforced. A new exclusive lane connector ramp was paved in the North Shepherd interchange median to aid the transition for buses and vans from concurrent flow travel to contraflow travel (see Figure 4-17). These improvements began in November 1980 and were completed about four months later.

The operating period of the concurrent flow lane (6-8:30 AM) was the same as for the contraflow lane during the morning peak period, and the two types of lanes were treated essentially as one priority treatment. Those vehicles authorized to use the contraflow lane were also authorized to travel on the concurrent flow lane. Responsibilities for the operation and monitoring of the concurrent flow lane were assumed by all parties involved in operating and monitoring the contraflow lane (i.e, set-up crew, wrecker service, police patrols, etc.).

There were no diamond symbols painted on the surface and no pylons separating the concurrent flow lane from the left-most mixed traffic lane. It was possible for vehicles to enter and exit the lane at any point, although the operating rules prohibited exiting except for emergencies. Because access was physically unrestricted, use of the lane by unauthorizated vehicles was expected to be greater than in the case of the contraflow lane. However, since the width of the median shoulder ranged from 16 to 22 feet, it was possible

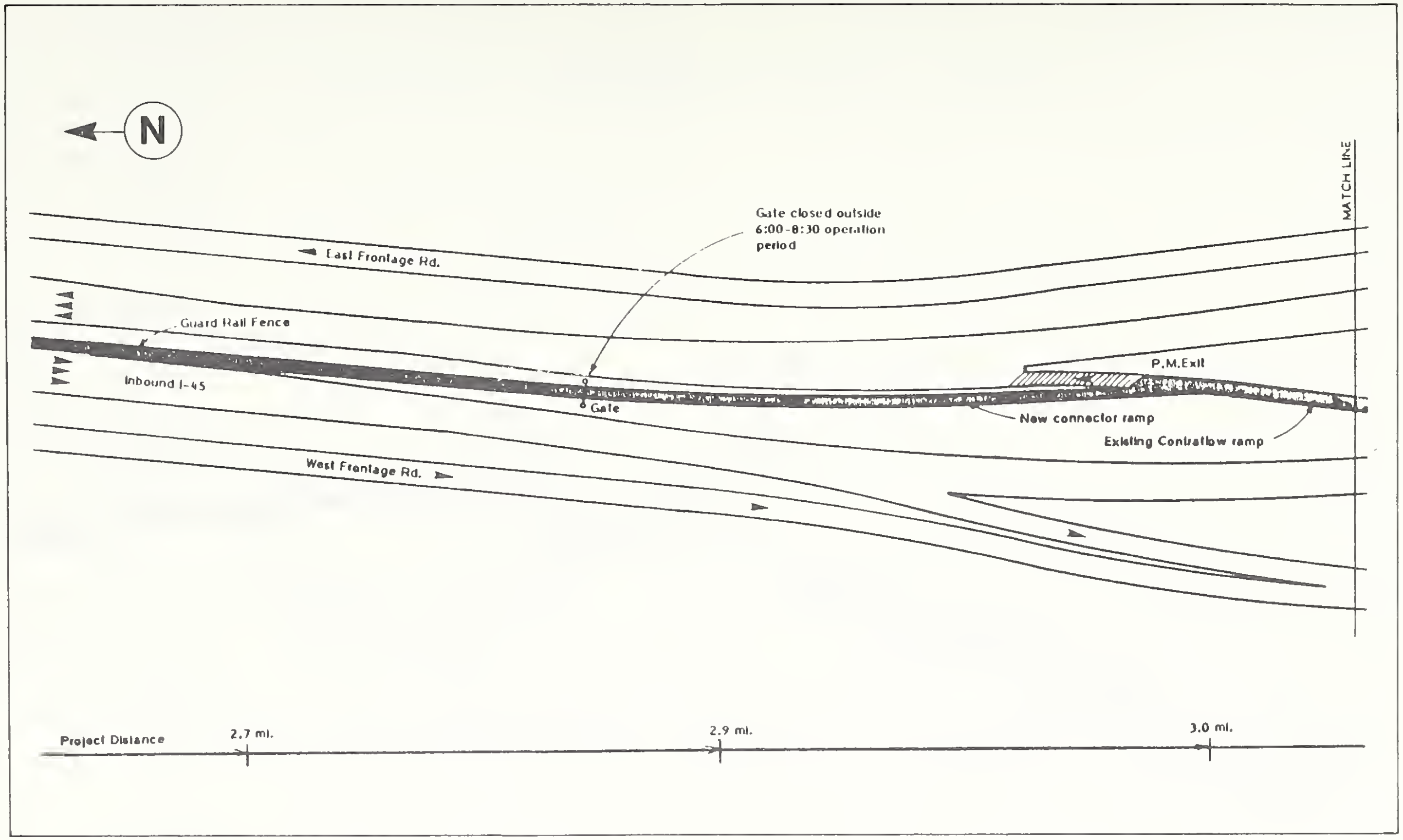

FIGURE 4-17. CONCURRENT LANE FLOW PLAN

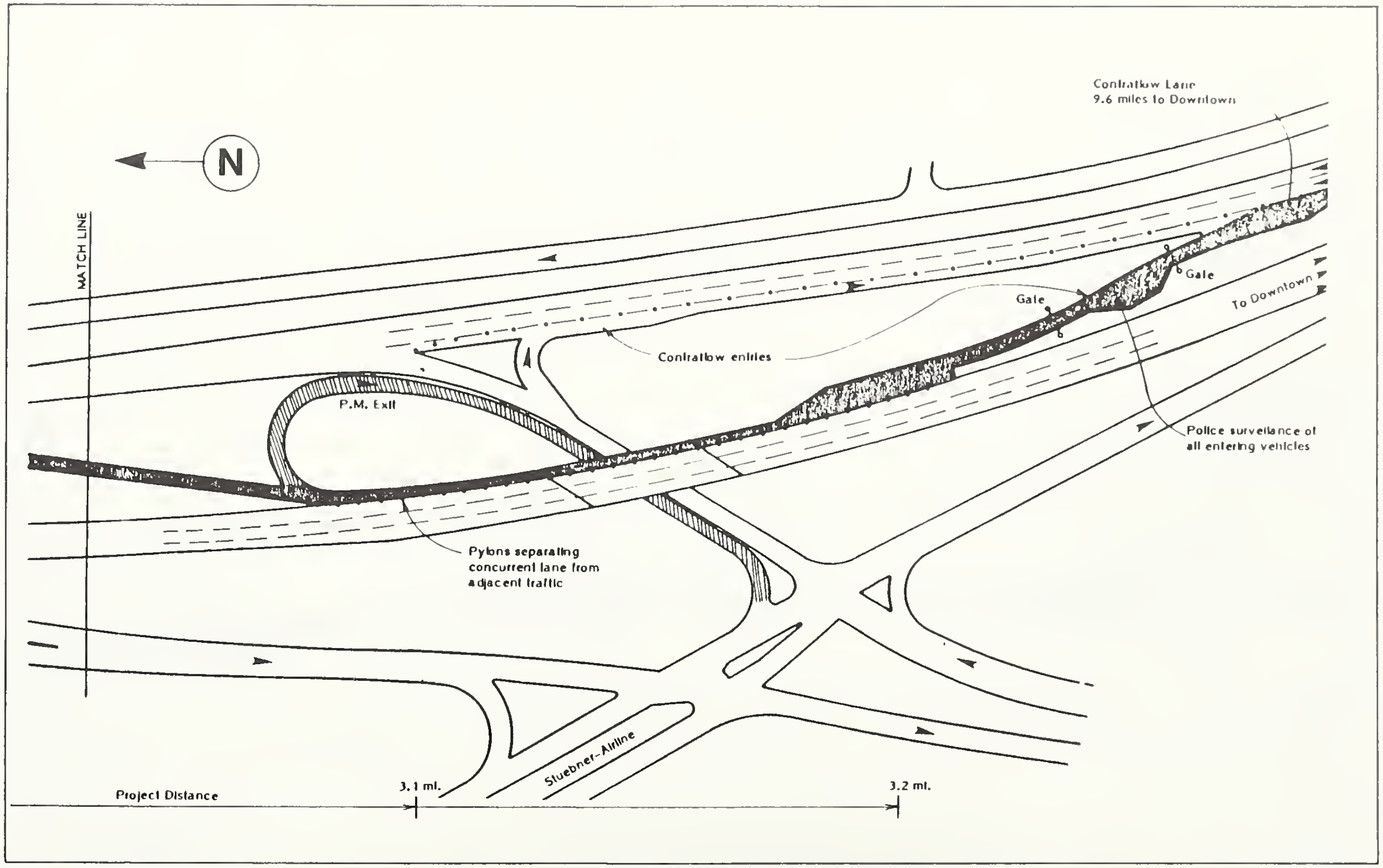

FIGURE 4-17. CONCURRENT LANE FLOW PLAN (CON'T.)

for police patrols to park next to the median barrier to both discourage and apprehend violators.

Initially, the concurrent flow lane was used by about 260 vehicles (75 buses and 185 vanpools). After one year of operation this number had increased to 335 vehicles. During the first month of concurrent flow lane operations, two police patrols (in addition to the two always on duty for the contraflow lane) were assigned exclusively to monitor the 3.3 miles. There were an average of seven violations per day observed during the first month. This rose to an average of 19 violations per day when the extra police patrols were removed and only two patrols monitored all 13 miles of the priority treatment.[1] After the first year of operation, violations averaged about six per day. Unlike some concurrent flow priority treatment projects in which autos with a minimum occupancy are authorized vehicles, since only buses and vans were allowed to use the lane, the detection of violators was relatively easy. This probably served to discourage unauthorized use of the lane.

4.4 COSTS

Capital costs associated with the freeway modifications needed for contraflow operation totaled $2,176,000. The cost of the daily contraflow lane operations including salaries, supplies (replacement of approximately 100 pylons each month), enforcement by two police patrols, wrecker towing, and general maintenance and repair for the lane and related electrical equipment averaged $63,250 per month for the first two months. For the next five months (November 1979 through March 1980), the average cost per month fell to $58,680 principally due to a reduction in the number of police patrols from four to two. Starting in April 1980, monthly operating costs averaged $44,700. This

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[1]Observations were made at three points along the freeway corresponding to the three freeway entrances along the length of the concurrent flow lane segment. Weaving in and out of the concurrent flow lane by unauthorized vehicles between observation points went undetected.

reduction resulted from the shift from contracted to METRO-operated wrecker service. In February 1981, operating costs were $50,200 per month and by October 1981 they were up to about $60,000 per month due primarily to increases in labor costs. Table 4-1 shows the break-down of monthly costs by category.

TABLE 4-1. CONTRAFLOW LANE MONTHLY OPERATING COSTS

	September 1979	November 1979	April 1980	February 1981
Labor[a]	$30,000	$30,000	$33,000	$38,000
Supplies	2,600	2,600	2,600	3,900
Enforcement[b]	14,200	7,600	6,100	5,800
Wrecker[c]	15,000	15,000	0	0
Maintenance and Repair	3,000	3,000	3,000	2,500
Total	$64,800	$58,200	$44,700	$50,200

[a] Initially, 18 employees including supervisors, which was increased to 20 beginning in April 1980.

[b] Average of four police patrols initially; reduced to two beginning in November 1979.

[c] When METRO's wrecker was delivered, the contract for private wrecker service was discontinued.

5. NORTH FREEWAY OPERATING CONDITIONS

With contraflow operation of the North Freeway, peak direction capacity was increased by utilizing capacity taken from the off-peak direction of travel. Associated with the implementation of the contraflow lane, then, were a number of potential impacts on freeway operating conditions and corridor travel characteristics. This chapter examines travel conditions existing on the North Freeway under normal operation and the changes which accompanied contraflow operation. This discussion includes traffic volumes, total person throughput, travel speeds, and accident rates. In addition, enforcement procedures and violation rates are discussed.

5.1 TRAFFIC VOLUMES

5.1.1 Non-Priority Lanes

As part of the contraflow lane feasibility study performed in 1975, traffic counts were made on the North Freeway at seven intersections within the proposed contraflow segment. These counts are summarized for both morning and afternoon peak periods and peak and off-peak directions in Table 5-1. (The locations of intersections corresponding to recording stations are presented in Figure 5-1.[1]) As shown, at the time the contraflow lane was proposed for the North Freeway (1975), peak period travel conditions were characterized by high traffic volumes and low levels of service. The peak direction level of service ratings over the proposed contraflow segment were C and D (stable to approaching unstable flow) with the exception of the freeway segment near the interchange with Airline Drive in the afternoon peak, which

[1]Since traffic volume counts at other than Link Road (where a permanent, automatic traffic counter is located) are normally not available, these volume counts are useful in terms of comparing the travel conditions over the length of the contraflow lane segment. Although freeway congestion became worse in the four years between collection of these data and the implementation of the contraflow lane, it is likely that the relative levels-of-service at different points on the freeway remained fairly constant.

TABLE 5-1. 1975 NORTH FREEWAY PEAK HOUR TRAFFIC VOLUME SUMMARY

INTERSECTION	Total Freeway Lanes	Peak Direction: Total Volume	Peak Direction: Per-Lane Volume	Peak Direction: LOS[1]	Off-Peak Direction: Total Volume	Off-Peak Direction: Per-Lane Volume[2] (Projected)	Off-Peak Direction: LOS[1,2] (Projected)	Directional Split[3]
					MORNING PEAK HOUR (7-8 AM)			
N. Shepherd Dr.	6	4550	1517	C	2830	1415	C	.62
Airline Drive	6	5200	1733	D	3090	1545	C	.63
Crosstimbers	8	6290	1573	C	3400	1134	B	.65
HB&T RR	8	6780	1695	D	3920	1306	B	.63
I-610	6	4920	1640	C	1600	800	A	.75
Link Road	8	7190	1797	D	2430	810	A	.75
North Street	10	8340	1668	C	2800	700	A	.75
					AFTERNOON PEAK HOUR (5-6 PM)			
N. Shepherd Dr.	6	5510	1837	D	3050	1525	C	.64
Airline Drive	6	5850	1950	E	3490	1745	D	.63
Crosstimbers	8	6550	1638	D	3550	1183	B	.65
HB&T RR	8	7340	1835	D	3970	1323	B	.65
I-610	6	4920	1640	C	1830	915	B	.73
Link Road	8	6720	1680	D	2970	990	B	.69
North Street	10	7560	1512	C	3320	830	A	.69

1 Level of service categories are defined as:
- A: Free flow; little or no restriction on speed or maneuverability.
- B: Stable flow; operating speed beginning to be restricted by other traffic.
- C: Stable flow; operating speed restricted.
- D: Approaching unstable flow; operating speeds subject to consdierable and sudden variation.
- E: Unstable flow; speeds and flow rates fluctuate.
- F: Forced flow; many stoppages.

2 Off-peak traffic volumes are distributed over one less lane than normally available for the purpose of reporting the expected LOS with contraflow operation. The 1975 LOS for off-peak traffic was the same or better than listed here, since actual per-lane volumes were 33-50 percent lower.

3 Proportion of total freeway traffic volume travelling in the peak direction.

Source: Texas State Department of Highways and Public Transportation, District 12-Houston, "Feasibility of Contraflow Lanes on I-45 (North Freeway) Houston, Texas," January, 1976.

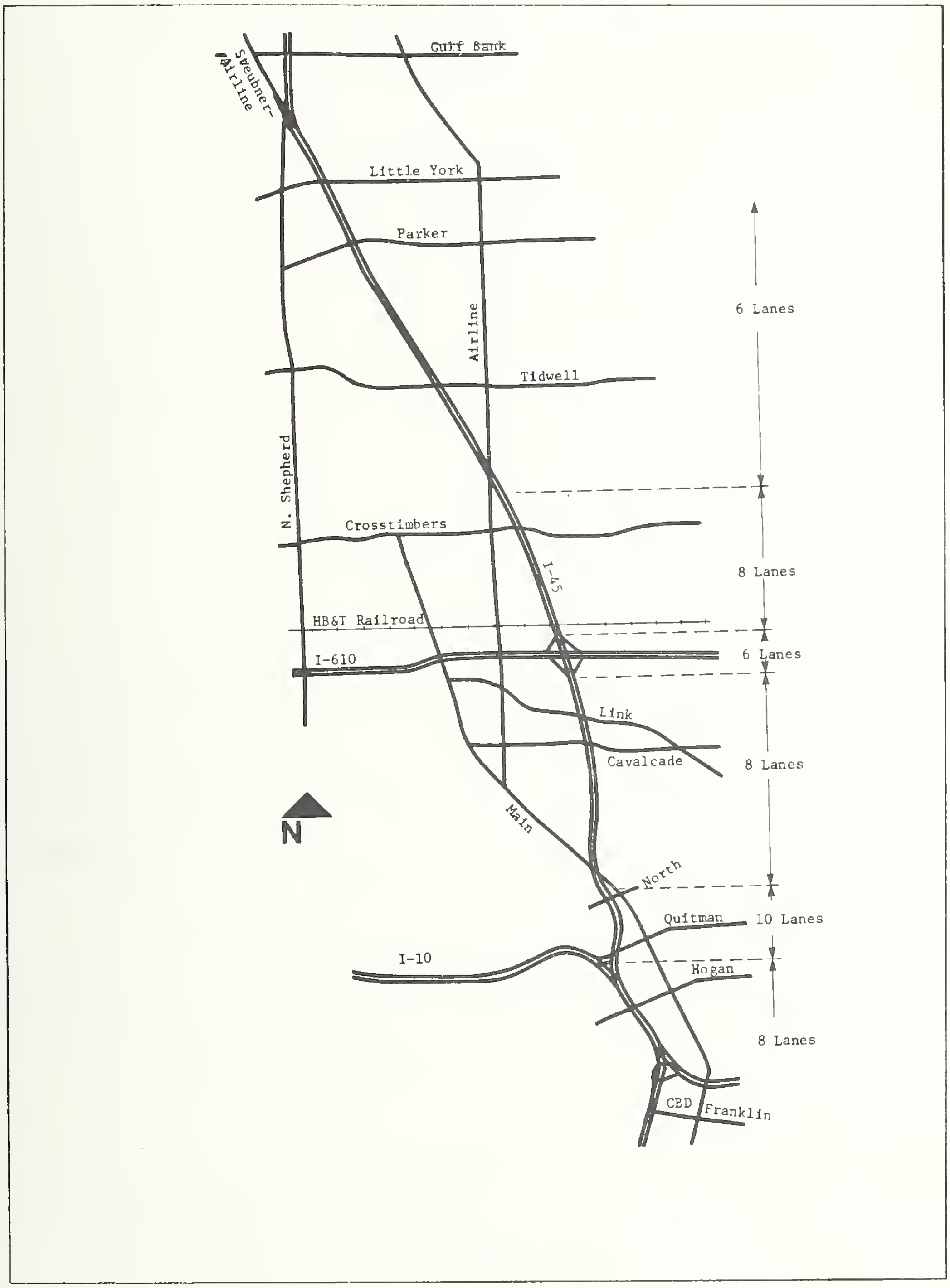

FIGURE 5-1. NORTH FREEWAY

was characterized as E--unstable flow. Note that although the peak direction volumes shown for both morning and afternoon varied with the recording location on the freeway due to differences in the number of lanes, the per-lane volume was generally in the range of 1,500 to 1,800 vehicles. The notable exception to this was the afternoon per-lane volume of 1,950 vehicles at Airline Drive (where the number of outbound lanes is reduced from four to three), which had the worst level-of-service rating (i.e., unstable flow). However, since bus and vanpool use of the contraflow lane was expected to result in a decrease in demand for peak direction non-priority freeway travel, any impacts on peak direction non-priority travel attributable to contraflow operation would be positive.

The levels of service listed in Table 5-1 for the off-peak direction are projections which take into consideration the "loss" of one lane that would occur with contraflow operation. Note that where there are three remaining off-peak direction lanes (i.e., those freeway sections with a total of eight or ten lanes), no problems were anticipated. However, the recorded afternoon off-peak volume north of the intersection with Crosstimbers was very high for just two travel lanes and it was anticipated that contraflow operation would result in a reduction in level of service to C or D if no remedial action were taken (i.e., ramp closures or ramp metering). The relatively low volumes recorded on the North Freeway at the interchange with I-610 reflect the large amount of traffic exchange which occurs between these two freeways.

The directional splits listed in Table 5-1 represent the proportion of total freeway traffic travelling in the peak direction at a specific point along the freeway, with higher directional splits typically indicative of more favorable conditions for contraflow operation. Overall, the directional split was somewhat lower during the afternoon peak period relative to that in the morning. This lower directional split, together with somewhat higher total traffic volumes in the afternoon, would lead to higher per-lane volumes in the off-peak direction (and lower levels of service) with contraflow operation. Despite the fact that afternoon contraflow operation appeared less promising than morning operation, the State Department of Highways and Public Transportation (SDHPT) recommended implementing contraflow operation during both peak periods. Again, it was felt that ramp metering or closure in certain areas could to a large extent remedy potential problems in the afternoon period.

The changes in North Freeway peak hour volumes and directional split as measured at Link Road for October 1977 through April 1982 are presented in Table 5-2.[1] As shown, by the time the contraflow lane was opened in August 1979, the directional splits had decreased (relative to 1975) from .75 to .71 in the morning and from .69 to .61 in the afternoon, primarily as a result of increased off-peak direction hourly volumes, which were up by 18 and 12 percent respectively for the morning and afternoon peak periods.

In addition to increased off-peak direction traffic, decreased peak-direction traffic volumes also contributed to these lower directional splits. For example, between 1975 and August 1979, peak direction volumes dropped from 7,190 to 6,970 in the morning and from 6,720 to 5,260 in the afternoon. This decrease in peak direction volumes probably reflects the degradation in level of service (and lower travel speeds) resulting from increased travel demand as traffic volumes on the North Freeway began to exceed freeway capacity.[2] The subsequent increase in AM peak direction volumes after the contraflow lane was opened would suggest that the increase in peak direction capacity resulting from contraflow operation led to somewhat improved peak-hour traffic conditions.

5.1.2 Contraflow Lane

The growth of contraflow lane vehicle use over time is illustrated in Figure 5-2. As shown, during the first week of operation, an average of 110 vehicles (29 buses and 81 vanpools) used the lane during each peak period. By

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[1]In comparing these hourly volumes, it is important to note that traffic counts alone are not necessarily a good indication of either demand or level of service. For example, when traffic volumes are near capacity, additional demand can result in lower recorded volumes as a result of lower travel speeds.

[2]Level of service ratings associated with the North Freeway traffic volumes at Link Road shown in Table 5-2 were not available. However, an indication of changes in average service levels for the entire portion of the North Freeway subjected to contraflow operation in terms of changes in travel speeds is presented in Section 5.2.

TABLE 5-2. NORTH FREEWAY TRAFFIC VOLUMES AND DIRECTIONAL SPLITS

	Average Weekday Traffic	Morning (7-8 AM) Peak Direction Volume[1]	Morning (7-8 AM) Off-Peak Direction Volume	Morning (7-8 AM) Directional Split	Afternoon (5-6 PM) Peak Direction Volume[1]	Afternoon (5-6 PM) Off-Peak Direction Volume	Afternoon (5-6 PM) Directional Split
1975		7190	2450	.75	6720	2970	.69
Oct 77-Feb 78	132590	6200	2970	.68	5270	3220	.62
Mar-Jul 78	136390	6640	2940	.69	5320	3230	.62
Jan-Apr 79	138730	6620	3010	.69	5480	3310	.62
May-Aug	137020	6970	2870	.71	5260	3340	.61
Sep-Dec	133918	6855	2803	.71	5142	3128	.62
Jan-Apr 80	136730	7240	2835	.72	5113	3120	.62
May-Aug	140758	7688	2853	.73	5113	3118	.62
Sep-Dec	140797	7430	2907	.72	4832	3150	.61
Jan-Apr 81	140213	7525	3194	.70	5190	3402	.60
May-Aug	143628	7703	3186	.71	5165	3328	.61
Sep-Dec	140068	7611	3263	.70	5364	3546	.60
Jan-Apr 82	142246	7281	3238	.69	5208	3357	.61

[1] Excluding contraflow lane vehicles.

Source: Texas State Department of Highways and Public Transportation, Automatic Traffic Counter reports for North Freeway at Link Road (just south of I-610).

December (just prior to the holiday period) utilization was up to 166 vehicles (36 buses and 130 vanpools). Subsequent growth in vehicle use was fairly steady and, by the end of May 1982, an average of 471 vehicles (103 buses and 368 vanpools) were using the contraflow lane during each peak period. Growth in van use of the contraflow lane was relatively steady, averaging about seven to ten vanpools per month. In contrast, the number of buses using the contraflow lane changed little except when new service was introduced from the North Shepherd Park-and-Ride lot in April 1980. The small increases in bus use other than this large increase were due to minor schedule changes by METRO and changes in the number of airport and intercity (non-METRO) buses using the contraflow lane. During its first week of operation, buses accounted for 26.4 percent of all vehicles using the contraflow lane. By May 1982 this had decreased somewhat to 21.9 percent. (Detailed discussions of the growth in bus and van use of the contraflow lane are presented in chapters 6 and 7, respectively.)

Figure 5-3 illustrates the growth in person movement during the 2 1/2 hour period of contraflow operation in the morning peak. As shown, during the first week of operation, an average of about 1,175 people were moved on the contraflow lane during each peak period. After one year of operation, utilization of the contraflow lane equaled that for the average non-priority lane, which was about 4,300 people per peak period. By May 1982, utilization had increased to about 7,800 people--an increase of over 560 percent versus a 327 percent increase in vehicle utilization of the contraflow lane relative to the first week of operation. Over this period, the average occupancy of contraflow lane vehicles increased from about 10.7 to 16.0, which reflects the greater increase in bus ridership relative to vanpooling shown in Figure 5-3.

The distribution of vehicle use of the contraflow lane by time of day during the morning and afternoon operating periods is illustrated in Figure 5-4. Note that in the morning, vehicle use of the contraflow lane is greatest between 6:45 and 7:00 AM and then falls off rather quickly. During the first month of contraflow operation (September 1979), 37 percent of all vehicles using the contraflow lane travelled within this peak 15-minute period. By May 1981, while the total number of vehicles observed between 6:45

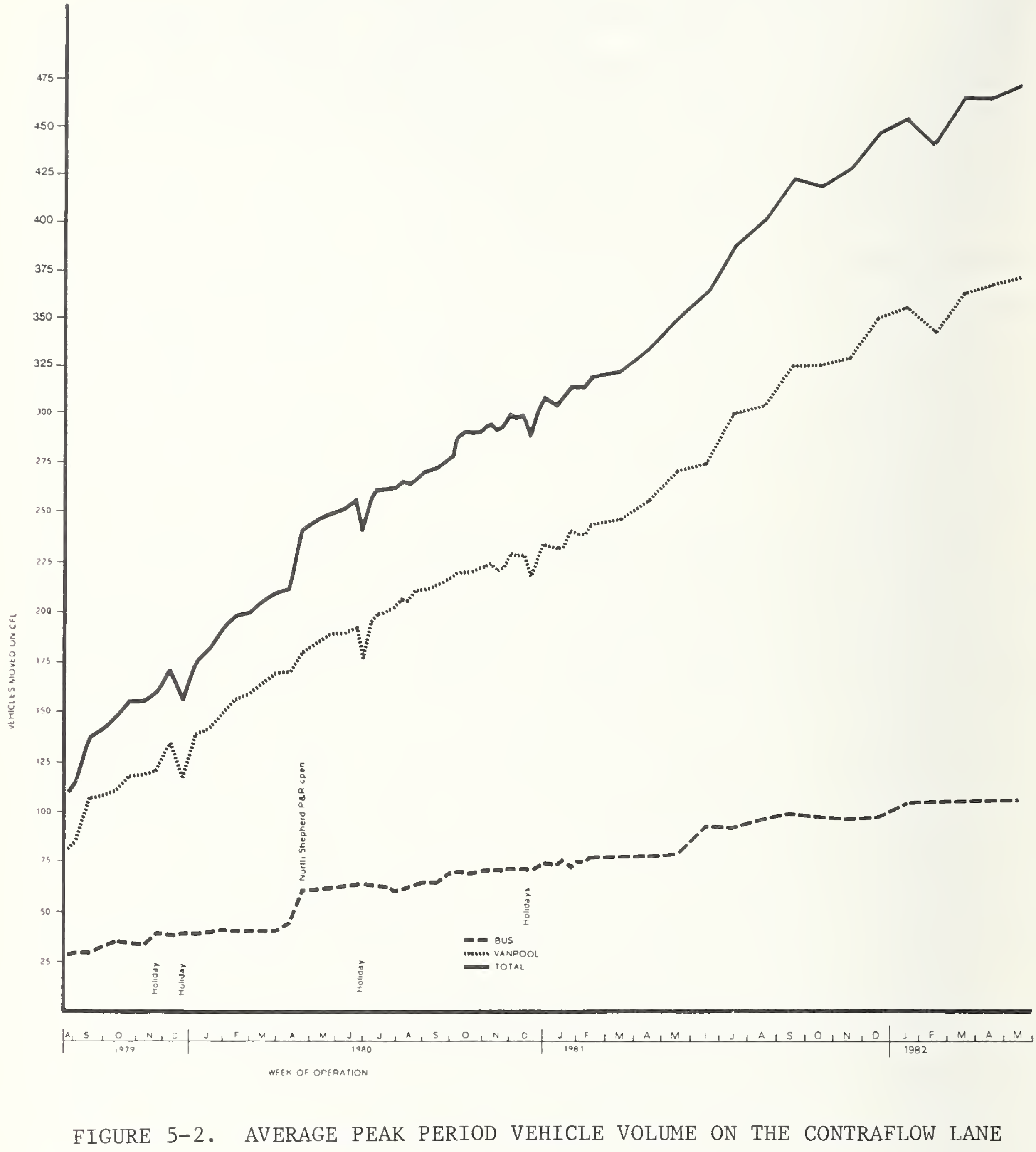

FIGURE 5-2. AVERAGE PEAK PERIOD VEHICLE VOLUME ON THE CONTRAFLOW LANE

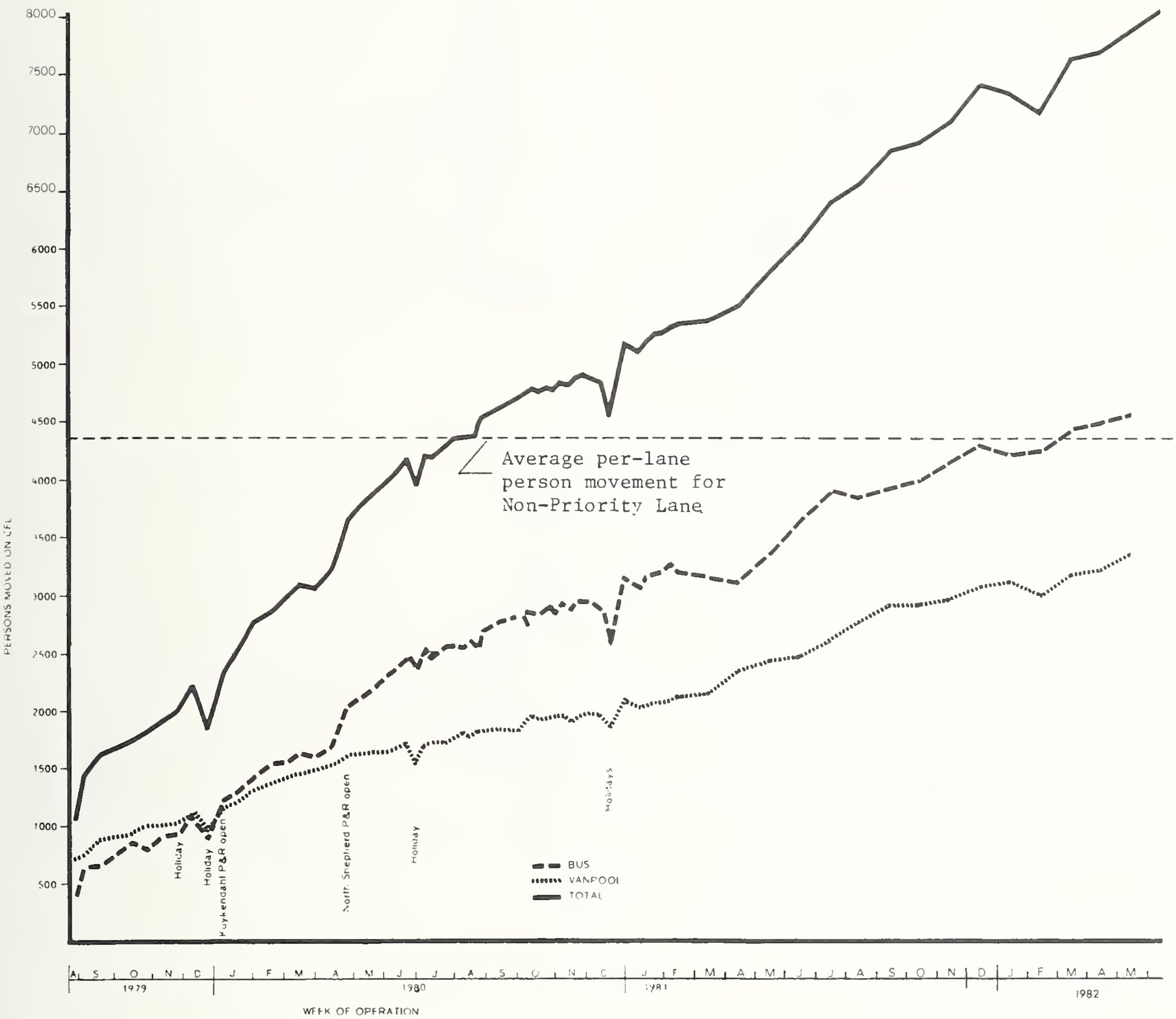

FIGURE 5-3. AVERAGE PEAK PERIOD PERSON VOLUME ON THE CONTRAFLOW LANE

and 7:00 AM more than doubled (from about 55 to 125), this represented only 22 percent of all vehicles using the contraflow lane during the morning operating period. In contrast, afternoon use was less peaked and demand was high at the beginning of the operating period. Many vanpools were ready to leave downtown before 4 PM, and typically lined up at the downtown entrance to the contraflow lane waiting for set-up procedures to be completed. These groups petitioned METRO to make the official starting time earlier than 4 PM. While METRO never changed the official time, the lane was always opened as soon as it was ready--typically at about 3:45.

5.1.3 Person Throughput--All Lanes

The growth in peak direction person throughput for the North Freeway between April 1979 and April 1982 is presented in Figures 5-5 and 5-6 for morning and afternoon peak periods respectively. As shown in Figure 5-5, the number of people travelling the North Freeway in the morning peak period increased from 19,420 in April 1979 to 26,600 by May 1982--an increase of 37.0 percent. Virtually all of this increased travel occurred on the contraflow lane. During the afternoon peak period (see Figure 5-6), person throughput of the North Freeway increased from 15,620 in April 1979 to 23,307 by May 1982--an increase of 49.2 percent. Almost all of this increase (94 percent) occurred on the contraflow lane.

5.2 TRAVEL SPEEDS

In assessing the impacts of the contraflow lane on freeway operating conditions, average travel speed serves as an excellent quantitative measure. In the absence of any growth in travel, implementation of the contraflow lane would be expected to have a positive impact on peak direction travel speeds. Not only would existing bus and van trips be diverted from the regular freeway lanes, but auto drivers shifting their travel modes would further lower demand for auto travel in the non-priority freeway lanes. On the other hand, the potentially adverse impact on off-peak direction travel resulting from reduced capacity was a major consideration in the assessment of contraflow

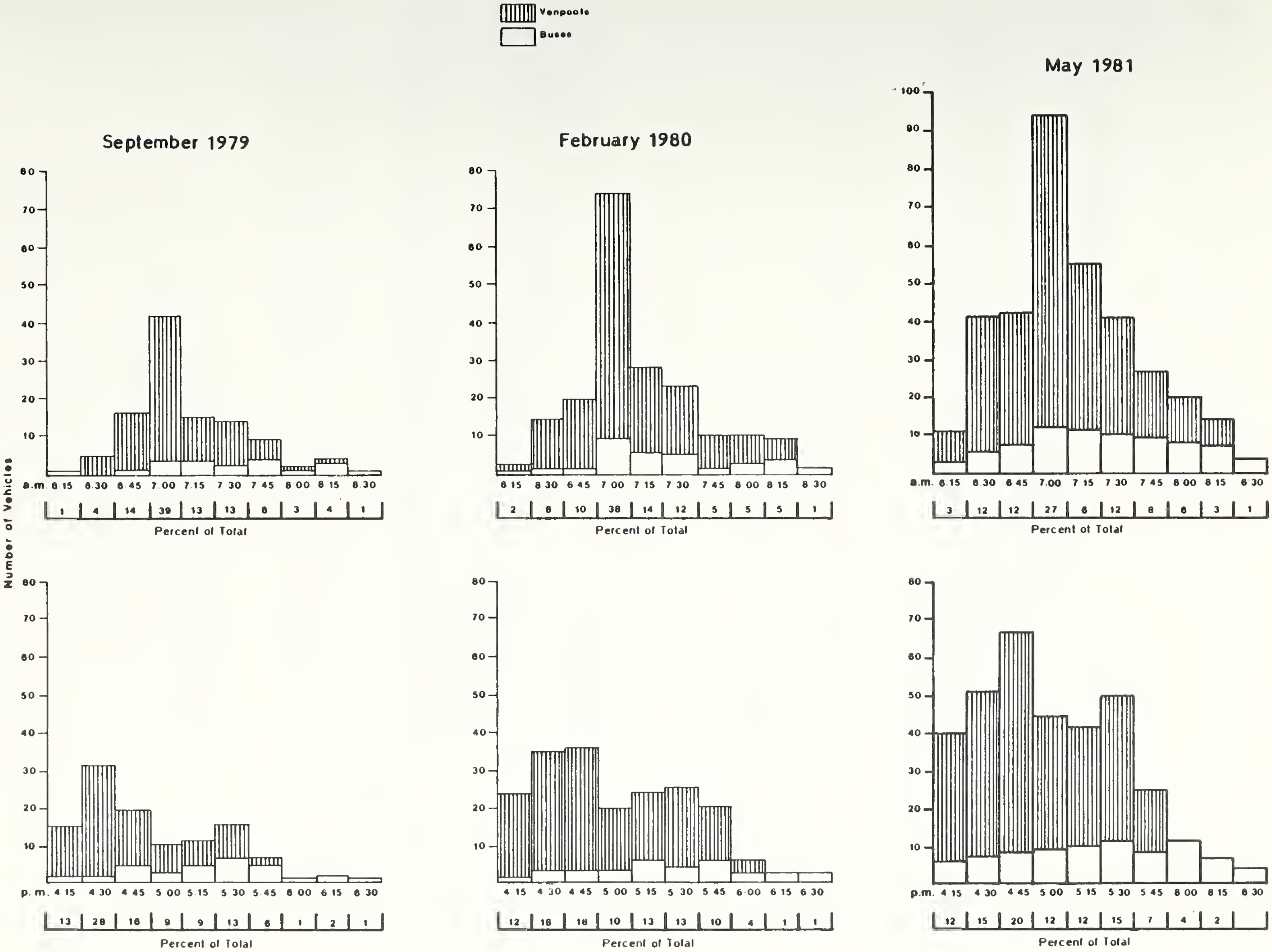

FIGURE 5-4. DISTRIBUTION OF CONTRAFLOW LANE VEHICLE USE

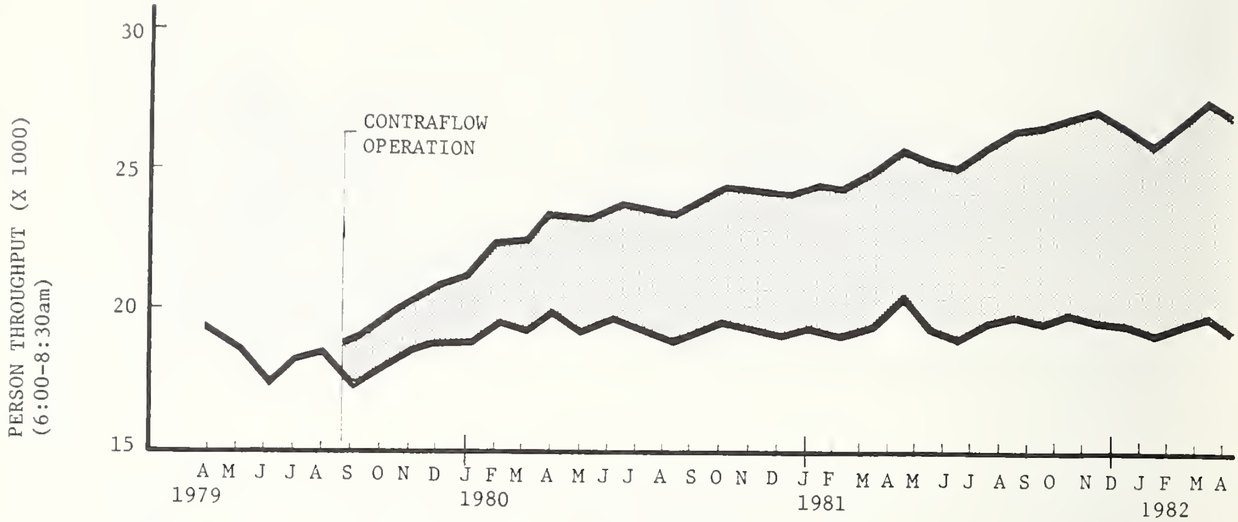

FIGURE 5-5. NORTH FREEWAY PERSON THROUGHPUT
(PEAK DIRECTION/AM PEAK PERIOD)

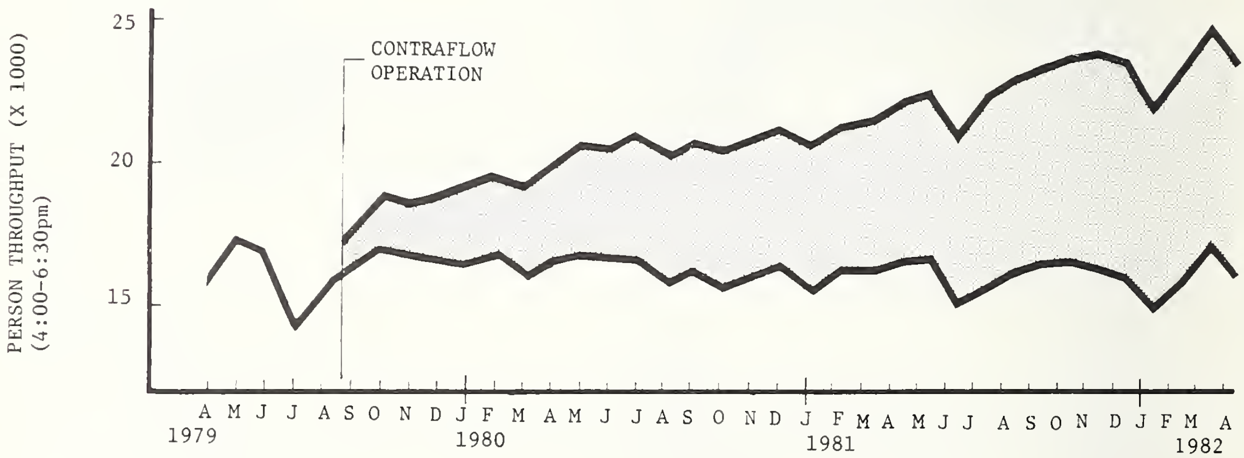

FIGURE 5-6. NORTH FREEWAY PERSON THROUGHPUT
(PEAK DIRECTION/PM PEAK PERIOD)

feasibility. This section examines the changes in travel speeds which occurred after the contraflow lane was implemented for peak direction, off-peak direction, and contraflow lane travel.

5.2.1 Peak Direction

Measures of North Freeway travel speeds prior to contraflow operation were made in January 1978 and again in August 1979. These, together with travel speeds measured in November 1979, about two months after the contraflow lane was opened, are summarized in Table 5-3 for peak hour, peak direction travel. As shown, the morning peak hour average speed inbound was between 22 and 26 miles per hour (mph) before the contraflow lane opened and was measured as 29 mph after two months of contraflow operation. Average speeds outbound in the afternoon were lower, ranging from 16 to 17 mph before the contraflow lane opened and approximately 21 mph afterwards. It would appear that at least initially, contraflow operation improved peak direction travel conditions during both the morning and afternoon peak periods.

Also presented in Table 5-3 are average speeds on the 5-mile segment of the North Freeway north of the contraflow lane terminus (i.e., between the intersection with North Shepherd and North Belt). As shown, between August and November 1979, average speeds decreased from 20 to 15 mph in the morning peak hour and from 40 to 34 mph in the afternoon peak hour. To some extent this decrease in average speed may be attributed to seasonal variations in auto travel. In the afternoon peak hour outbound, though, buses and vanpools merging into the non-priority lanes at the contraflow lane terminus caused some delays and was probably responsible for much of the decrease in average speeds.

5.2.2 Off-Peak Direction

The average travel speeds recorded for off-peak direction traffic are presented in Table 5-4. As shown, off-peak direction peak hour speeds for the contraflow segment of the freeway prior to contraflow operation ranged from 52 to 54 mph for the morning peak hour (outbound), and 48 to 51 mph for the

TABLE 5-3. SUMMARY OF NORTH FREEWAY PEAK DIRECTION TRAVEL SPEEDS--1978 AND 1979

	North Belt to North Shepherd[1] (5.0 mi)	North Shepherd to I-610 (5.1 mi)	I-610 to CBD (4.5 mi)	North Shepherd to CBD (9.6 mi)
AM INBOUND - PEAK HOUR				
Pre-Contraflow--Jan 1978	NA	--	--	22 mph
Pre-Contraflow--Aug 1979	20 mph	24 mph	29 mph	26
With Contraflow Lane--Nov 1979	15	26	33	29
PM OUTBOUND - PEAK HOUR				
Pre-Contraflow--Jan 1978	NA	--	--	17 mph
Pre-Contraflow--Aug 1979	40 mph	19 mph	14 mph	16
With Contraflow Lane--Nov 1979	34	21	20	21

1 This is north of the Contraflow Lane segment.

Source: Texas State Department of Highways and Public Transportation Speed Runs on the North Freeway, unpublished data.

TABLE 5-4. SUMMARY OF NORTH FREEWAY OFF-PEAK DIRECTION TRAVEL SPEEDS--1978 THROUGH 1980

	North Belt to North Shepherd[1] (5.0 mi)	North Shepherd to I-610 (5.1 mi)	I-610 to CBD (4.5 mi)	North Shepherd to CBD (9.6 mi)
AM OUTBOUND - PEAK HOUR				
Pre-Contraflow--Jan 1978	NA	--	--	52 mph
Pre-Contraflow--Aug 1979	57 mph	53 mph	55 mph	54
With Contraflow Lane--Nov 1979	53	48	52	50
With Contraflow Lane and Ramp Closures--Jan 1980	NA	--	--	53
PM INBOUND - PEAK HOUR				
Pre-Contraflow--Jan 1978	NA	--	--	48 mph
Pre-Contraflow--Aug 1979	48 mph	51 mph	50 mph	51
With Contraflow Lane--Nov 1979	27	34	48	39
With Contraflow Lane and Ramp Closures--Jan 1980	NA	--	--	45

1 This is north of the Contraflow Lane segment.

Source: Texas State Department of Highways and Public Transportation Speed Runs on the North Freeway, unpublished data.

afternoon peak hour (inbound). Although the afternoon speeds were somewhat lower than those for the morning, in neither case were off-peak direction travel speeds much lower than the 55 mph speed limit prior to contraflow operation. After the contraflow lane was opened, off-peak direction traffic slowed to 50 mph in the morning and to 40 mph in the afternoon.[1] The introduction of ramp closures mitigated some of the adverse effects of the contraflow lane, and average speeds rose to 53 and 45 mph, respectively.[2]

As with peak direction travel, off-peak direction travel speeds were lower between I-610 and North Shepherd than to the south of I-610. In the morning peak hour, speeds never averaged much below free-flow travel conditions, even in the 5-mile freeway segment north of the contraflow lane. In the afternoon, however, the average speed was 34 mph in the northern part of the contraflow lane segment. On the 5-mile segment of the North Freeway north of the contraflow lane terminus (i.e., between the intersection with North Shepherd and North Belt), the average speed for inbound travel in the afternoon dropped from 48 to 27 mph. This fairly dramatic reduction was the result of traffic backing up from the point where three lanes of off-peak direction traffic merge into two lanes at the beginning of the contraflow lane.

5.2.3 Contraflow Lane

The speed limit on the contraflow lane was 45 mph from August 28, 1979, through August 3, 1980. On August 4, 1980, the limit was raised to 55 mph and

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[1]During the first week of contraflow operation, off-peak direction travel speeds slowed to 35 mph for both morning and afternoon peak hours. This was due to unfamiliarity with the new procedures and did not represent new equilibrium conditions.

[2]When ramp closures were initiated, average off-peak direction travel speeds for people on the North Freeway increased. However, travellers who were prevented from entering the freeway and forced to remain on the frontage road, incurred longer travel times (and, thus, slower average speeds). These slower travel speeds have not been accounted for in the measures of average freeway travel speed presented in Table 5-4.

a 3-second rule for spacing between authorized vehicles was imposed.[1] During the summer just prior to the speed limit change, speed checks revealed that most contraflow vehicles were travelling at speeds between 45 and 55 mph.[2] Based on the observed contraflow speeds and the good safety record of vehicles using the contraflow lane, METRO and SDHPT felt the speed change was appropriate. Another speed check made in October 1980 indicated that the average speed for buses was 57 mph and that for vans was 54 mph.

5.2.4 Travel Times

The impacts of these changes in average speeds on travel times are summarized in Table 5-5. As shown, the increase in average peak direction speeds resulted in an average travel time savings of 4.1 minutes during the morning peak hour and 8.6 minutes during the afternoon peak hour for the non-priority lanes over the 9.6 miles for which contraflow operation was implemented.

Reductions in peak hour travel times for contraflow lane travellers were quite substantial. Travel times were reduced by 56 percent in the morning (from 24.0 to 10.5 minutes) and by 71 percent in the afternoon (from 36.0 to 10.5 minutes) relative to those existing prior to contraflow operation. On a round-trip basis, travel time savings for vehicles using the contraflow lane amounted to 40 minutes.

The travel time impacts for off-peak direction travel on the freeway were minimal once ramp control measures were implemented. In the morning, there was essentially no change in travel time. In the afternoon, travel times were increased by only 1.3 minutes. It should be noted that while travel times on the freeway itself had not been affected significantly, diversions caused by

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[1]That is, a minimum of three seconds should elapse before a vehicle reached the point at which the vehicle in front of it was when the three seconds started.

[2]When peak direction traffic in the non-priority freeway lanes was travelling at a speed higher than 45 mph, contraflow lane drivers probably tried to keep up with or pass vehicles in non-priority lanes so as not to "lose" time.

TABLE 5-5. CHANGES IN PEAK HOUR TRAVEL TIMES DUE TO CONTRAFLOW OPERATION

AVERAGE PEAK HOUR TRAVEL TIME (MINUTES)[1]			
	Before Contraflow Operation	After Contraflow Operation	Differences (After-Before)
NON-PRIORITY LANES (Peak Direction)			
AM	24.0	19.9	-4.1
PM	36.0	27.4	-8.6
CONTRAFLOW LANE			
AM	24.0	10.5	-14.5
PM	36.0	10.5	-25.5
OFF-PEAK DIRECTION			
AM	10.9	10.9	--
PM	11.5	12.8	+1.3

[1]Travel times are for the 9.6 mile freeway segment for which contraflow operation was implemented.

ramp closures most likely resulted in increased travel time for off-peak direction travellers who had been using those entrance ramps which were closed.

5.3 ACCIDENTS

5.3.1 Non-Priority Lanes

Accident rates in terms of accidents per million vehicle-miles (MVM) and average number of accidents per month on the North Freeway during the 6-month period prior to contraflow operation and the 6-month period after the contraflow lane was opened are presented in Table 5-6.[1] In addition to overall accident rates, results are presented separately for peak versus off-peak direction and morning (4:00 - 9:00 AM) versus afternoon (2:00 - 7:00 PM).

As shown in Table 5-6, the accident rate for peak direction travel during the morning period decreased slightly from 1.8 to 1.5 accidents per MVM after the contraflow lane was opened. In the afternoon period, a much more pronounced decrease was observed (from 3.3 to 1.8 accidents per MVM, a decrease of 45.5 percent). Overall, the accident rate for both morning and afternoon travel dropped from 2.6 to 1.7 accidents per MVM. This reduced frequency of accidents in the peak direction of travel is consistent with the improved travel conditions resulting from contraflow operation and other traffic improvements mentioned earlier.

The accident rate for off-peak direction travel appears to have increased somewhat with contraflow operation. In the morning, the accident rate rose from 1.8 to 2.3 accidents per MVM (an increase of 27.8 percent), while in the

[1]Note that 8.4 miles of freeway (from the 1500 block to the 8900 block) have been included in these accident data. The 1500 block is the southernmost point at which the contraflow lane removes one lane from off-peak direction traffic. The contraflow terminus is at the 7800 block, but accidents further north (to the 8900 block) have been included. The periods of 4-9 AM and 2-7 PM were used to correspond to the time when the contraflow lane is being set up and taken down as well as when it is actually in operation.

TABLE 5-6. NORTH FREEWAY ACCIDENT RATES

	Morning 4-9 AM		Afternoon 2-7 PM		Total	
	Before	After	Before	After	Before	After
PEAK DIRECTION						
Accidents/month	6.6	6.0	13.9	7.9	20.5	13.9
Accidents/MVM[1]	1.8	1.5	3.3	1.8	2.6	1.7
OFF-PEAK DIRECTION						
Accidents/Month	3.1	4.4	7.7	9.7	10.8	14.1
Accidents/MVM	1.8	2.3	2.2	3.0	2.1	2.7
TOTAL, BOTH DIRECTIONS						
Accidents/Month	9.7	10.4	21.6	17.6	31.3	28.0
Accidents/MVM	1.8	1.8	2.8	2.3	2.4	2.1

Note: Weekday accidents in the 1500-8900 blocks only.

[1] Million Vehicle-Miles

Source: City of Houston Police Department accident/incident reports for the North Freeway.

afternoon the accident rate increased from 2.2 to 3.0 accidents per MVM (an increase of 36.4 percent). This is consistent with the degradation of traffic conditions resulting from the loss of one travel lane with contraflow operation.

Overall, the total accident rate for the non-priority lanes of the North Freeway during both morning and afternoon periods and in both peak and off-peak directions decreased slightly from 2.4 to 2.1 accidents per MVM after the contraflow lane was opened, a decrease of 12.5 percent.

The distribution of accidents by freeway segment is presented in Table 5-7. (Freeway locations referred to in Table 5-7 are identified in Figure 5-7.) As shown, the largest increase in accidents for the off-peak direction during the morning occurred between block numbers 3800 and 5000. (The average number of accidents per month increased from 04. to 1.7). This corresponds to the location where the number of lanes available in the off-peak direction during contraflow operation decreases from three to two. In the afternoon, the greatest increase in accidents for off-peak direction travel occurred between block numbers 7500 and 8900. As shown, the average number of accidents per month increased from 0.4 to 3.8 in this portion of the freeway. Again, contraflow operation forced a merge within this segment from three lanes to two for off-peak direction travellers.

5.3.2 Contraflow Lane

In 18 months and 1.66 million vehicle-miles of contraflow lane travel, there were only 4 accidents (2.4 per million vehicle-miles) involving vehicles in the contraflow lane.[1] These accidents resulted in two fatalities and a number of serious injuries. The first accident, in November 1979, involved neither a bus nor van. A non-priority vehicle swerved into the contraflow

[1]There were three additional accidents involving contraflow vehicles during the ten months following the 18-month demonstration period (i.e., between March and December 1981). In each of these, an off-peak direction vehicle entered the contraflow lane and struck a contraflow vehicle. While there were no fatalities, the last of these accidents caused several people to be hospitalized.

TABLE 5-7. AVERAGE MONTHLY ACCIDENTS BY PROJECT SEGMENT

Block Numbers[1]	Morning (4-9 AM)		Afternoon (2-7 PM)	
	Before	After	Before	After
PEAK DIRECTION	(Southbound)		(Northbound)	
1500-2800	1.0	1.7	2.3	1.3
2800-3800	1.7	1.3	3.1	1.8
3800-5000	1.9	1.3	4.0	1.7
5000-6200	0.6	0.2	0.9	1.0
6200-7500	0.7	0.7	1.7	0.8
7500-8900	0.7	0.8	1.9	1.3
OFFPEAK DIRECTION	(Northbound)		(Southbound)	
1500-2800	0.9	0.3	0.6	0.7
2800-3800	0.9	0.7	3.1	0.7
3800-5000	0.4	1.7	1.9	2.2
5000-6200	0.1	0.2	0.7	1.0
6200-7500	0.1	0.8	1.0	1.3
7500-8900	0.7	0.7	0.4	3.8

[1] Refer to Figure 5-7 for Block Number Locations

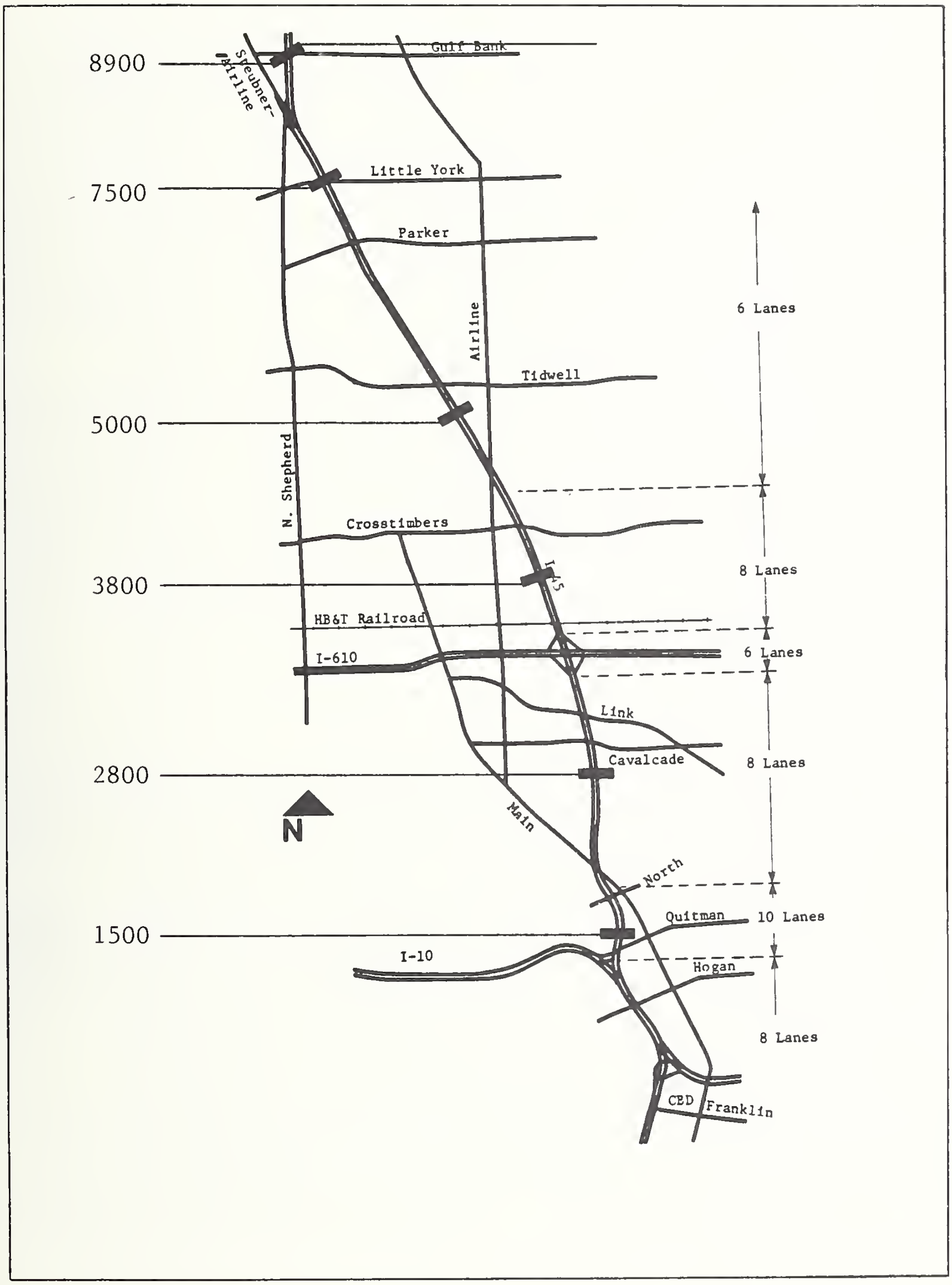

FIGURE 5-7. NORTH FREEWAY SEGMENTS FOR AVERAGE MONTHLY ACCIDENTS

lane to avoid hitting an auto ahead and instead hit a METRO truck which was involved in the pylon removal operation. There were no serious injuries.

In January 1980 there was a 4-vehicle accident caused by an auto/truck collision in the non-priority lanes which sent the auto into the contraflow lane. The auto struck a contraflow van and the van was pushed back into the regular lanes where it hit another auto. The driver of the second auto had minor injuries, and there was some damage to the vehicles. The contraflow lane was closed for about 20 minutes as a result of the accident.

The first of the two contraflow-related fatalities occurred in April 1980 in rainy weather conditions. An auto skidded out of control, entered the contraflow lane, and was hit by a van. The auto driver was killed instantly, the van driver suffered broken bones. Four van passengers received minor injuries. The other fatality (September 1980) was the result of a contraflow bus hitting a pedestrian who was attempting to cross the freeway.

5.4 CONTRAFLOW LANE VIOLATION RATES

Enforcement of the restrictions on contraflow lane use was relatively straightforward. There were few violations and when they occurred there was little disruption for authorized lane users. Characteristics of the contraflow lane which aided enforcement procedures were the limited number of access points for lane entry and the fact that only buses and vans were eligible to use the contraflow lane. The latter meant that autos on the lane were highly visible as violators.

In addition to restricting lane use to buses and vanpools, there was the additional restriction that both the driver and vehicle had to have prior authorization to use the lane. Since relatively few buses or vans which travelled on the North Freeway failed to obtain this authorization, violations rarely occurred.

The extent of violations (both successful and unsuccessful attempts at contraflow lane entry) are illustrated in Figure 5-8. There is no information about the motivation of the violators, so it is unclear how many drivers were "lost" and how many decided to flagrantly ignore the signs indicating

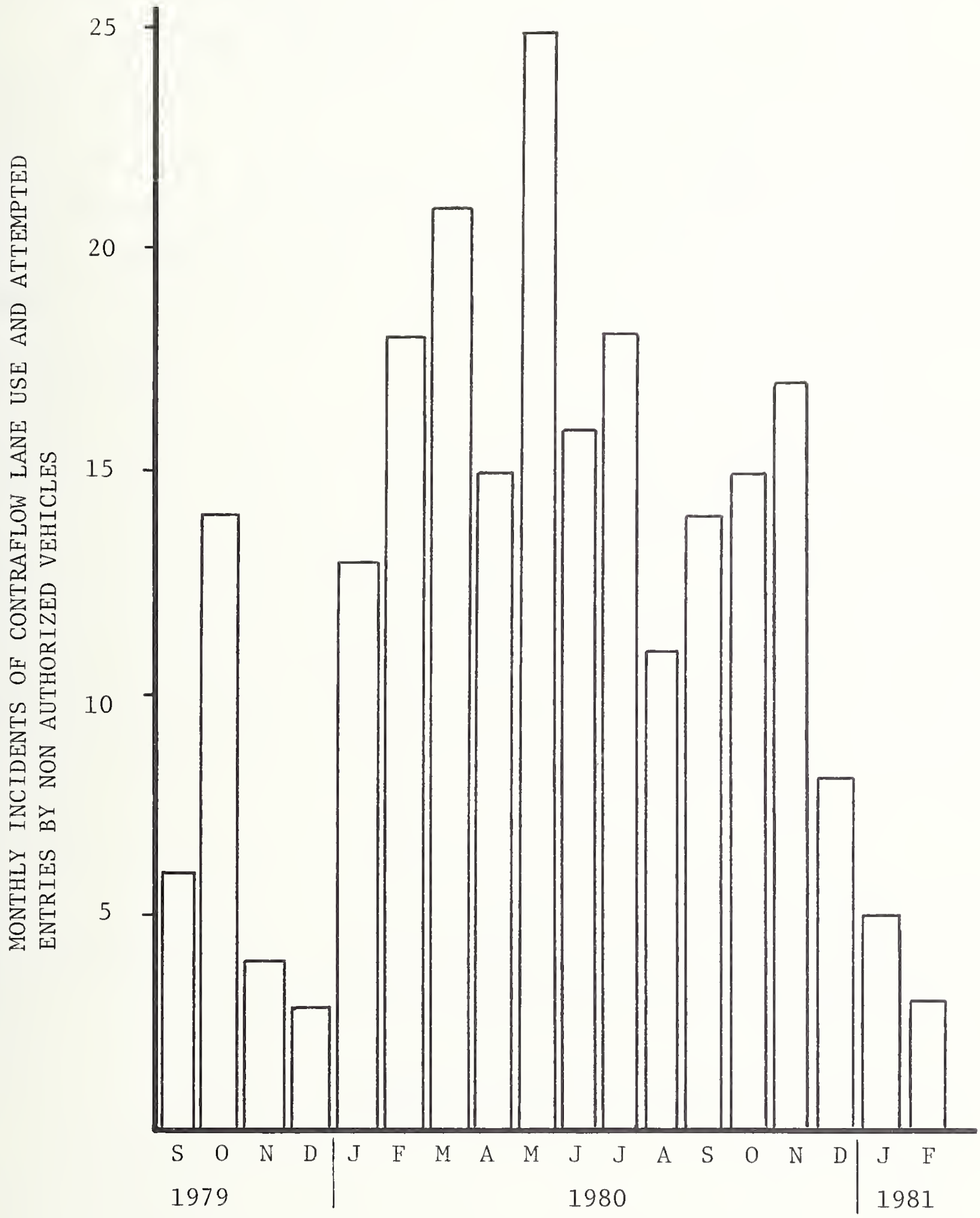

FIGURE 5-8. INCIDENTS OF UNAUTHORIZED USE OF THE CONTRAFLOW LANE

"Authorized Vehicles Only." There is no pattern to the number of violations. It would appear that the number of violations in any month depended on isolated conditions such as weather, extent of congestion, and drivers who had never before driven on the North Freeway.[1]

The number of violations in a given month ranged from 3 to 25. The fact that the majority of violations were in the afternoon period is probably due to both the different engineering configurations of the morning and afternoon entrance ramps and because worse travel conditions in the afternoon may have given more encouragement for unauthorized drivers to try to use the contraflow lane.

Violations of rules governing the use of the lane by only those vans, buses and drivers having prior authorization were not as easy to detect as the restriction against autos using the lane. The requirement for vehicles to display authorization stickers on front and back windshields was checked daily as each vehicle entered the lane. Other rules such as having the contraflow driver's authorization card in possession and carrying the required safety equipment were enforced on a "spot check" basis. Spot checks were made only twice during the 18-month demonstration period and very few violations were detected.

5.5 KEY FINDINGS

Key findings related to changes in North Freeway operating conditions associated with contraflow operation include the following:

5.5.1 Travel Time Savings for Contraflow Lane Users

Because of the relatively congested conditions existing on the North Freeway prior to contraflow operation, the length of the contraflow lane (9.6 miles) and its operation during both the morning and afternoon peak periods,

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[1]While it is posssible that the number of violations could fluctuate based on the rigorousness of the enforcement/lane observation procedures, it is unlikely since there were, at a minimum, three people monitoring the entrance and one person monitoring the mid-point crossover. Marked police cars were also stationed at these points.

travel time savings for contraflow lane users was quite significant. During the morning peak hour, for example, the average travel time prior to contraflow operation for the 9.6 mile segment of the North Freeway corresponding to the contraflow lane was 24 minutes. After the contraflow lane was opened, those travelling by bus or vanpool cover the same distance in 10.5 minutes. In the afternoon peak hour, average travel times were reduced from 36 to 10.5 minutes. On a round-trip basis, peak-hour travel times were reduced by 40 minutes for those using the contraflow lane.

5.5.2 Utilization

As a result of the relatively large travel time savings associated with contraflow operation together with other corridor transportation improvements, utilization of the contraflow lane was quite extensive. During its first week of operation, an average of about 1,175 people used the contraflow lane during each peak period. After one year of operation, utilization of the contraflow lane equaled that for the average non-priority lane (about 4,390 people per peak period). By May 1982, utilization had increased to about 7,800, which was 81.4 percent greater than that for the average non-priority lane.

5.5.3 Impacts on Non-Priority Travellers

For peak direction travellers, average morning peak hour travel speeds on the North Freeway between the intersection with North Shepherd and downtown Houston averaged about 24 mph prior to contraflow operation, and increased to 29 mph after two months of contraflow operation. In the afternoon, average peak hour travel speeds increased from about 17 to 21 mph. It would appear, then, that contraflow operation improved peak direction travel conditions during the first few months of operation. One notable exception, though, were peak direction travel conditions just north of the contraflow lane terminus. Here, buses and vanpools merging into the non-priority travel lanes from the contraflow lane reduced average travel speeds from 40 to 34 mph during the afternoon peak hour.

For off-peak direction travellers, average morning peak hour speeds dropped slightly from about 53 to 50 mph. In the afternoon peak hour, off-peak direction speeds decreased from 50 to 40 mph immediately after the contraflow lane was implemented. Subsequently, the introduction of ramp closures mitigated some of the adverse effects of contraflow operation and average speeds increased to 53 and 45 mph in the morning and afternoon, respectively.

5.5.4 Accidents

The overall accident rate for that portion of the North Freeway subjected to contraflow operation during both morning and afternoon peak periods and in both peak and off-peak directions decreased by 12.5 percent from 2.4 accidents per million vehicle-miles (MVM) during the 6-month period prior to contraflow operation to 2.1 accidents per MVM during the first six months of contraflow operation. This was the result of a 35 percent decrease in the accident rate for peak direction travel, and a somewhat smaller increase in the accident rate for off-peak direction of travel.

5.5.5 Enforcement

Enforcement of the restrictions on contraflow lane use was relatively straightforward. There were few violations, and when they occurred, there was little disruption for authorized lane users. The number of violations in a given month ranged from 3 to 25, with an average of about 14 per month.

6. BUS OPERATIONS AND RIDERSHIP

Bus ridership in the North Freeway corridor increased dramatically over the course of the demonstration period as a result of contraflow operation and other significant improvements in the level of transit service available within the North Freeway corridor. This chapter describes the park-and-ride and bus services available prior to contraflow operation, the improvements made in these services throughout the demonstration period, and the costs associated with these improvements. In addition, the growth in bus ridership is examined in an attempt to isolate the effects of the contraflow lane from increased transit service and other factors.

6.1 NORTH FREEWAY CORRIDOR PARK-AND-RIDE AND BUS SERVICES

6.1.1 Park-and-Ride Lots

Although not funded under the demonstration project, the North Freeway park-and-ride lots were an integral component of the corridor improvement program. Ever since its creation, the Metropolitan Transit Authority of Harris County (METRO) had been planning the development of park-and-ride lots in all corridors of the transit district. Prior to contraflow operation, a number of small church and shopping center parking lots were used on an informal basis as park-and-ride lots for the two private bus routes serving the North Freeway corridor at that time. With the beginning of contraflow operation, attention was focussed on improving park-and-ride bus service in the North Freeway corridor.

In August 1979, when the contraflow lane was ready for use, the park-and-ride lots being constructed by METRO were not completed. However, because of delays already incurred in the demonstration schedule, the decision was made to begin contraflow operations using two temporary park-and-ride lots: the Champions Park-and-Ride lot and the Greenspoint Park-and-Ride lot. (See Figure 6-1). The former was leased by METRO from a church at a cost of $1 per year and was located about 22 miles from downtown and approximately 3

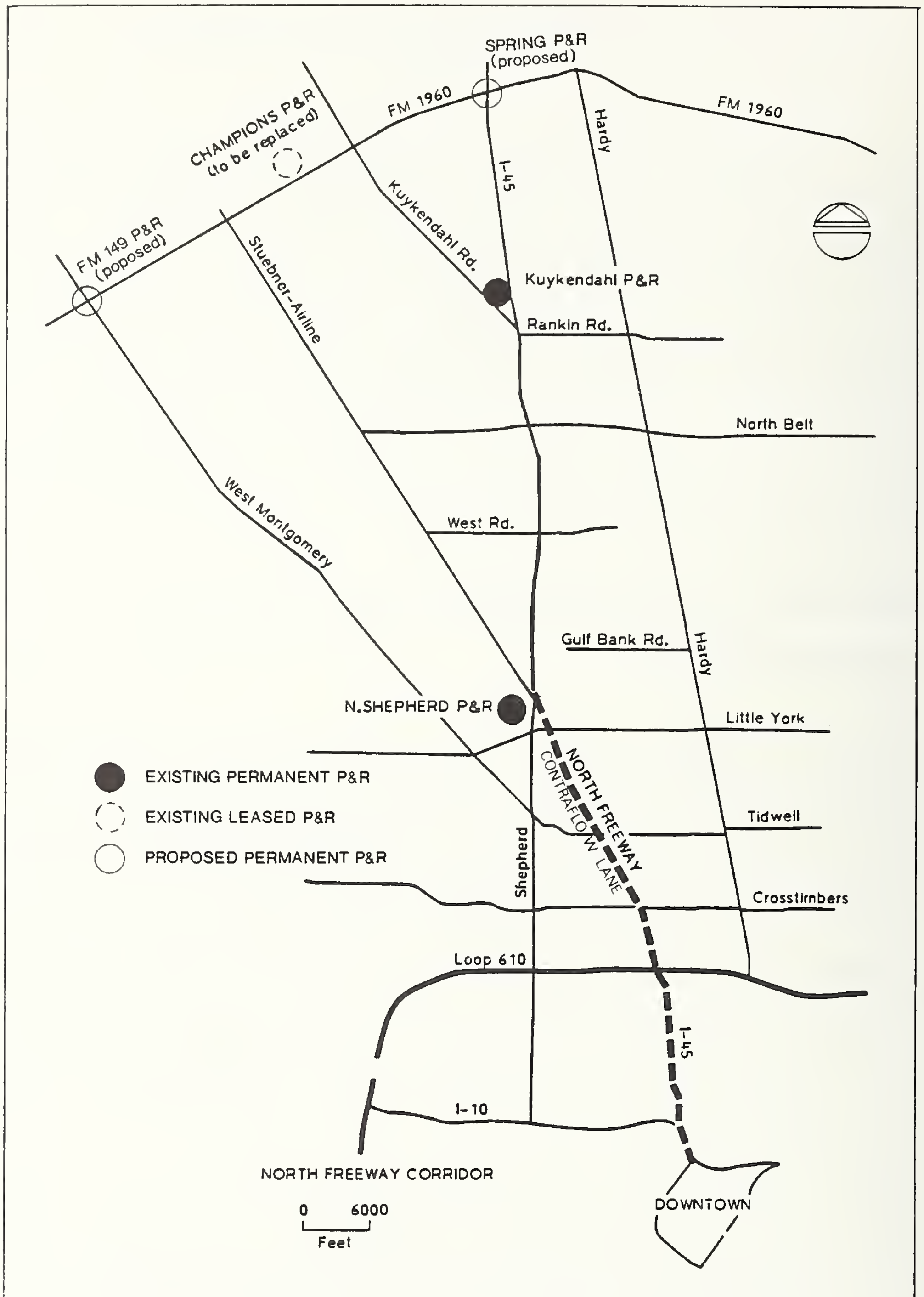

FIGURE 6-1. NORTH FREEWAY CORRIDOR PARK-AND-RIDE LOTS

miles west of the North Freeway. It had capacity for 330 cars, but was unimproved in terms of separate drop off areas or a sheltered bus loading area. While officially considered as a temporary park-and-ride facility, the Champions lot was in use throughout the demonstration period and will continue to be used until completion of the Spring Park-and-Ride lot, which is currently scheduled for mid-1982.

The Greenspoint Park-and-Ride lot was another temporary facility instituted while the Kuykendahl lot was under construction. From August through November 1979, this was located at the Greenspoint Shopping Mall (about 16 miles from downtown). When the beginning of the holiday shopping season necessitated the relocation of the park-and-ride lot, the Aldine High School Stadium (two miles closer to downtown) was used.

In January 1980, the Kuykendahl Park-and-Ride lot opened (17 miles from downtown), replacing the Greenspoint Park-and-Ride lot. This lot was located on a 12-acre site near the North Freeway frontage road at approximately 6.5 miles north of the contraflow lane terminus. It had 1,300 parking spaces, a kiss-and-ride drop off area, and a covered bus boarding area (see Figure 6-2). In addition, there is space for expansion on eight adjacent acres owned by METRO. Construction of the Kuykendahl Park-and-Ride facility cost $2,100,000 and was funded entirely by METRO. The land for this lot was purchased in May 1979. When the lot was opened on January 14, 1980 it was the first METRO owned and operated park-and-ride lot in the region.

The development of the North Shepherd Park-and-Ride lot at the contraflow lane terminus was an element of the original corridor improvement plan. Planning for this park-and-ride lot began in July 1976, and the land was purchased in April 1977. Construction began in January 1979 and the lot opened on April 28, 1980. Funding for the land purchase and lot improvements ($2,160,000) was provided by Federal Aid Urban Systems money (70 percent) and the Texas State Department of Highways and Public Transportation (SDHPT) budget (30 percent). The lot had 750 parking spaces, separate access for bus and kiss-and-ride operation, and a 4,000 square foot space frame sheltered loading area.

FIGURE 6-2. KUYKENDAHL PARK-AND-RIDE LOT

6.1.2 Bus Service

Since the City of Houston, through the Houston Transit System (HouTran), was the public transit operator prior to the formation of METRO in January 1979, public transit service initially was concentrated within the city limits which, in the North Freeway Corridor, extend as far as the North Shepherd Drive interchange. Prior to its dissolution, HouTran was operating express bus service on the North Freeway only between the interchange at Crosstimbers and downtown (See Figure 6-1). At the time the contraflow lane feasibility study was conducted, these routes, representing a total of 25 bus trips per day with an average peak period ridership of about 25 per trip, were considered as potential contraflow lane users in anticipation of the availability of a contraflow entrance/exit at the I-610 interchange, the mid-point of the contraflow lane. However, because the mid-point entrance was never opened to allow regular access between I-610 and the North Freeway contraflow lane, these routes were never able to take advantage of the contraflow lane.[1]

In addition to the HouTran buses, Oliver Bus Lines operated two private commuter bus routes on the North Freeway prior to August 1979. Both bus routes (FM 1960 Express and FM 149 Express) had a line haul distance of about 25 miles and entered the freeway at or north of the North Shepherd interchange. In January 1979, the area in which these routes operated became part of METRO's jurisdiction. Due to limitations of METRO's fleet size, though, Oliver Bus Lines continued operating the routes under contract to METRO. Just prior to the opening of the contraflow lane, these routes collectively averaged 265 daily AM peak period passengers.

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[1]While use of the mid-point entrance at the I-610 interchange appeared possible in the design stage, its general use in normal contraflow operations was not feasible due to the amount of weaving needed to make the transfer between I-610 and the contraflow lane. METRO has never opened the crossover for normal travel and its use to date has been restricted to the emergency exit of authorized vehicles from the contraflow lane to the regular North Freeway lanes.

When contraflow operations began in August 1979, there were four bus routes which used the contraflow lane. Two of these were the Oliver Bus Lines' routes and the other two were new METRO park-and-ride routes. One of these new routes, the Champions Park-and-Ride service, operated non-stop to downtown from a leased church parking lot 25 miles to the north. Each peak period, two of the buses continued from downtown to the Texas Medical Center, City Post Oak, and Greenway Plaza activity centers to the west and south. The second route, the Greenspoint Park-and-Ride, was a temporary service instituted while the Kuykendahl Park-and-Ride lot was under construction. Again, due to limitations of METRO's fleet size, bus services for these and other routes implemented during the demonstration period were contracted from private operators.

The growth of bus service in the North Freeway corridor over the course of the demonstration period is presented in Figure 6-3. During the first few months of contraflow bus service, there were 32 METRO bus trips per peak period on the North Freeway. While it was intended that all of these trips would use the contraflow lane, due to slight daily variations in bus running times and contraflow lane opening and closing times, some trips near the beginning or end of the peak period were forced to use the regular freeway lanes.[1] In addition to the METRO buses, intercity and airport buses travelling the North Freeway between 6:00-8:30 AM and 4:00-6:30 PM also used the contraflow lane. Actual use of the lane by buses during the first four months averaged about 28 trips per peak period. In October, additional bus trips were added to the Greenpoint and Champions routes, bringing the average number of peak period bus trips up to about 35. In January 1980, when the Kuykendahl route replaced the Greenspoint route, there were on average seven additional bus trips per peak period, bringing the contraflow average up to about 42.

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[1]Since the travel time differentials between the contraflow lane and regular freeway lanes at either end of the two peak periods was small, there was no great loss of time for these bus trips.

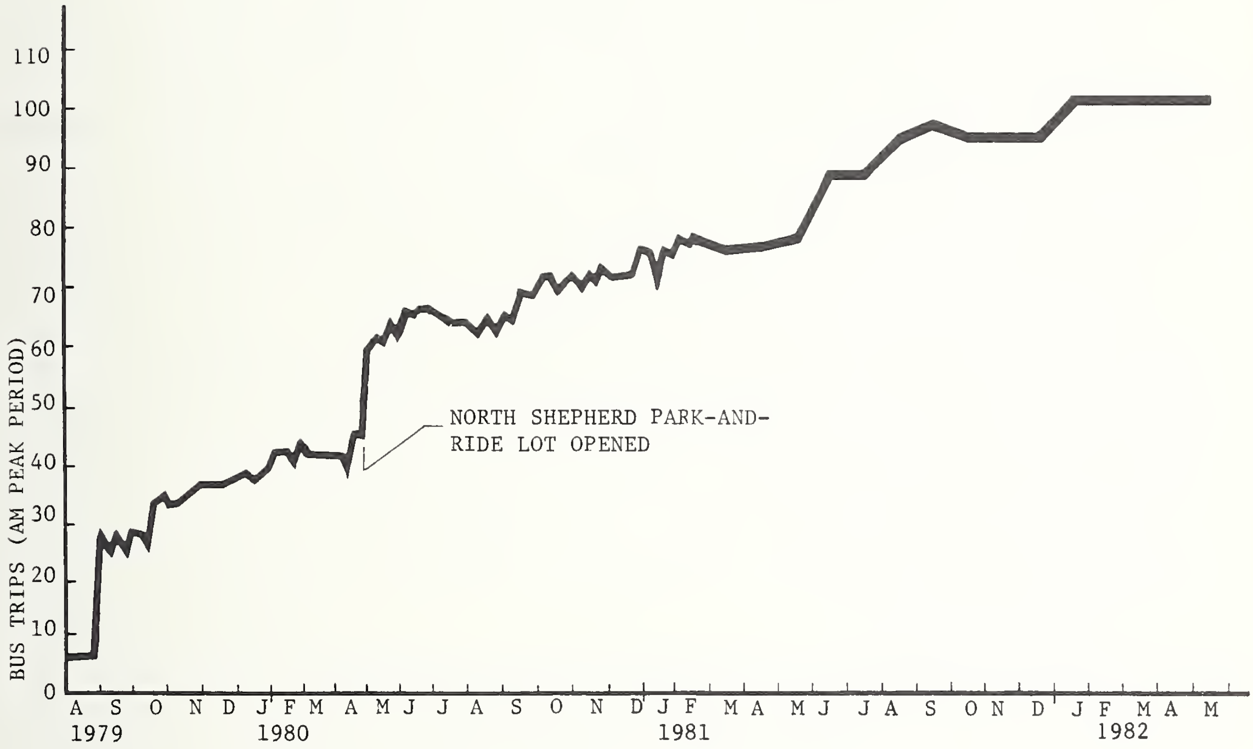

FIGURE 6-3. GROWTH IN NORTH FREEWAY BUS SERVICE (AM PEAK PERIOD)

At the end of April 1980, the North Shepherd Park-and-Ride route began operation, originating from the newly constructed lot at the contraflow lane terminus. The introducton of this service added 16 bus trips per peak period. When an extra morning and extra afternoon trip were added to the FM 149 Express route one week later, the number of buses using the contraflow lane was up to about 60 buses per peak period. Over time, additional bus trips were added to routes on an "as needed" basis. By May 1982, there was an average of 103 bus trips using the contraflow lane per peak period.

6.1.3 Fares

There were three fare-payment options available for those riding contraflow lane buses:

1. monthly pass;
2. 40-ticket book; or
3. single ticket.

Monthly passes were good for unlimited travel for the month on all METRO services which did not require a more expensive pass. Tickets, purchased in books or individually, were good only on METRO-contracted buses operating on the contraflow lane. Forty-ticket books were valid for three months from time of purchase. The payment of cash to a non-METRO employed bus driver (including contraflow drivers) was not permitted. This led to an informal system of free first-time rides for people not having tickets, since tickets could not be purchased at the park-and-ride lots.

The fare for METRO-contracted buses using the contraflow lane was $60 per month (for either the monthly pass or the 40-ticket book) until January 9, 1980, at which time the cost was adjusted to $55 per month, or $1.40 for a one-way trip. This change was the result of a restructuring of METRO's fare system for park-and-ride and express bus routes so that fares reflected trip distance. A zone system based on concentric rings was established with a base fare of $25 per month for trips within five miles of downtown. Each concentric ring beyond this base zone included an additional five miles from the downtown area and added $10 per month to the fare. The North Shepherd Park-and-Ride route, which began operation after the fare structure was adjusted, had a somewhat lower fare ($35 per month, or 90 cents for a one-way ride) because of its closer proximity to downtown relative to the other contraflow bus routes.

6.1.4 Costs

The cost to METRO of providing North Freeway bus service averaged $325 per bus and driver per day when contraflow operation began.[1] Due to automatic cost escalator clauses in the contracts (for cost of living, fuel, etc.), the average cost two years later was $400 per bus and driver per day. On average, each bus could be used for 1.4 trips since some buses made 2 trips per peak period. In February 1981, the averge monthly cost for the five contracted bus routes was approximately $340,000. Assuming that all bus riders paid fares on a monthly basis, average monthly fare revenues at that time were $145,630.

6.2 GROWTH OF BUS RIDERSHIP AND PARK-AND-RIDE LOT UTILIZATION

6.2.1 Bus Ridership

The growth in average daily AM peak bus ridership on the North Freeway between August 1979 and May 1982 is presented in Figure 6-4.[2] As shown, immediately prior to contraflow operation average daily AM peak ridership was 265. With the opening of the contraflow lane (and the accompanying increase in bus service) ridership rose sharply to about 4,500 after 33 months of contraflow operation--an increase of 1,600 percent. Major deviations to this generally steady increase occurred in December of 1979 and 1980--ridership

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[1]The actual cost incurred by the contract bus companies for providing this service is not known.

[2]Average daily AM peak period ridership data were available on a weekly basis between August 1979 and February 1981, after which time only monthly averages of daily AM peak period ridership were available.

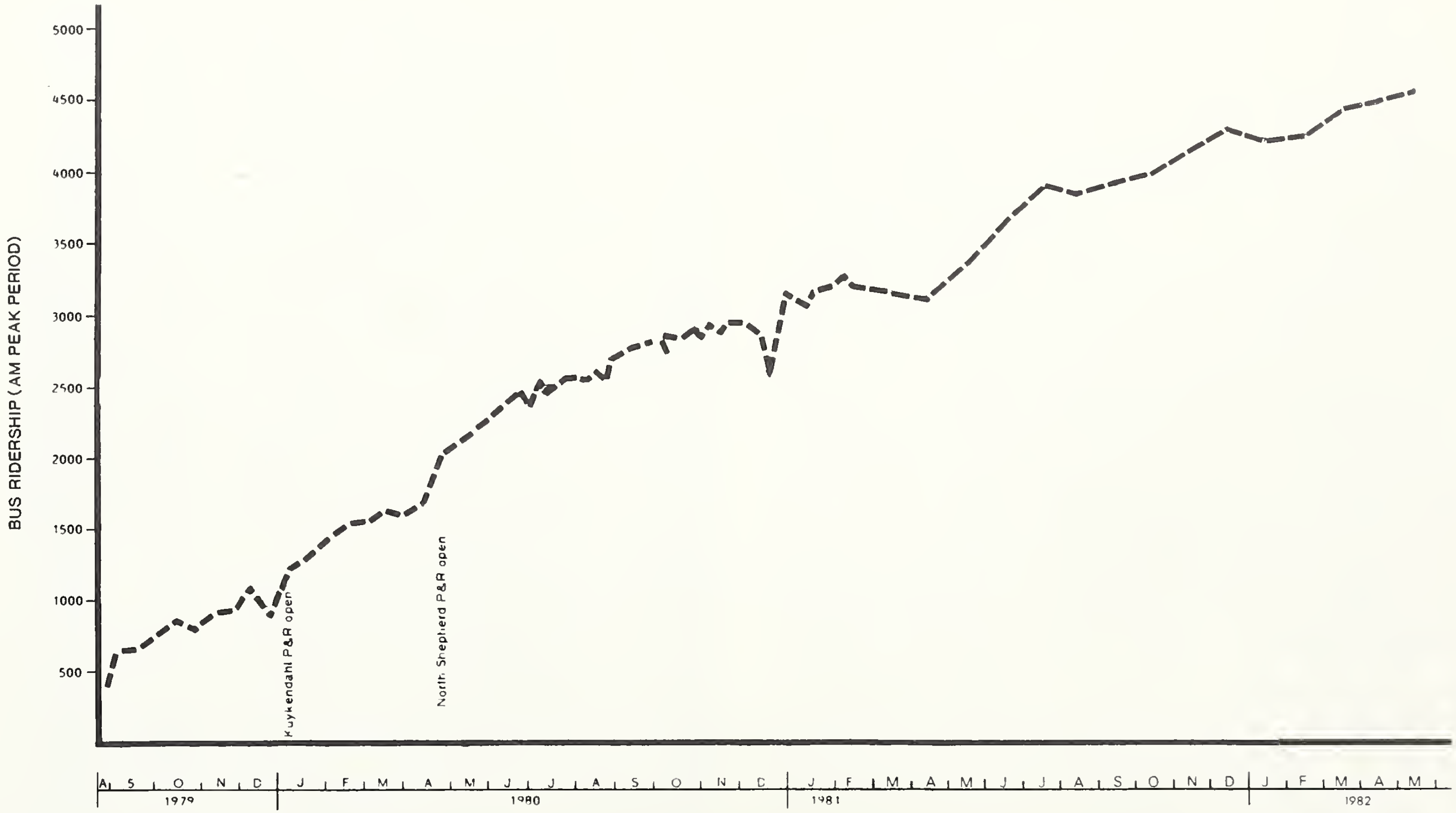

FIGURE 6-4. GROWTH IN BUS RIDERSHIP (AM PEAK PERIOD)

decreases corresponding to Christmas holidays--and in April of 1980, which involved a very sharp increase in ridership corresponding to the opening of the North Shepherd Park-and-Ride Service.

The relationship between increased bus capacity and ridership growth is perhaps best represented by the trend in average load factors during this period which are presented in Figure 6-5. When the contraflow lane opened in late August 1979, the number of bus trips on the North Freeway increased by 300 percent. The response to this sudden increase in capacity, though, was a much more gradual increase in ridership. As a result the average load factor dropped rather dramatically from .75 immediately prior to the opening of the contraflow lane to about .27 during the first week of operation. The average load factor then began to increase, and, after about six months, eventually reached and then exceeded the original .75 level. When the North Shepherd Park-and-Ride lot opened (April 1980), the average load factor again dropped, but only to about .70. Within three months the average load factor was up to about .85. By May 1982, the average load factor had increased to .88.

Some of the increase in ridership between August 1979 and May 1982 was undoubtedly the result of increased transit availability. However, the fact that load factors increased by 17.3 percent would suggest that other improvements in transit service (e.g., the contraflow lane) also contributed to this increase in ridership, particularly in view of the fact that the service areas of the five contraflow bus routes overlapped to a certain extent.

Some insight into the influence of transit availability relative to other improvements is provided by looking at ridership trends of just those routes which were in existence prior to contraflow operation (see Figure 6-6). As shown, average daily AM peak period ridership on the two bus routes in operation prior to the opening of the contraflow lane (i.e., FM 107 Express and FM 112 Express) was 265. After nine weeks of contraflow operation, this had dropped to about 225. This decrease was most likely the result of shifts in ridership to the two new routes which began operation when the contraflow lane was opened, since the service areas of these routes overlapped. (Route-specific ridership data were not available for the first seven weeks

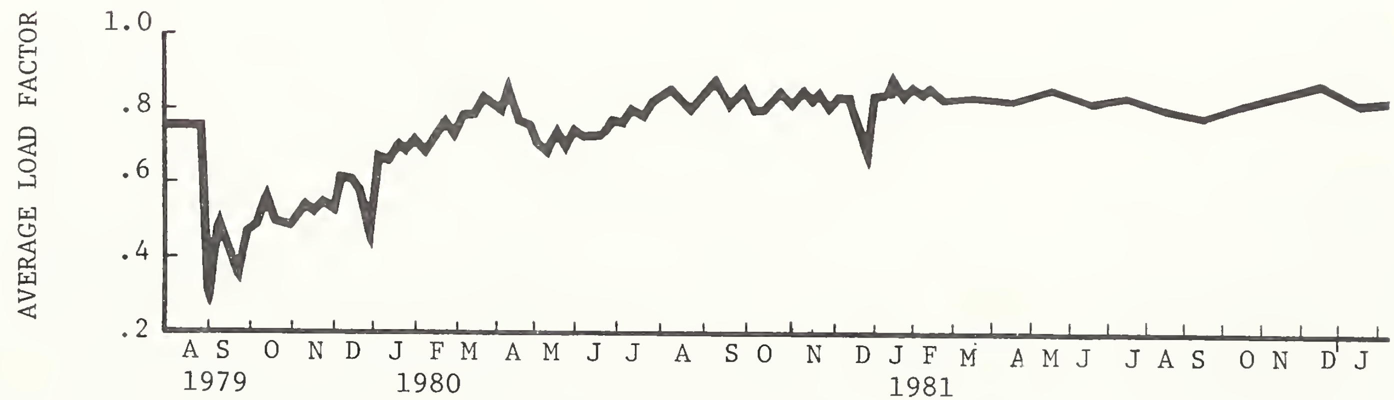

FIGURE 6-5: AVERAGE AM PEAK PERIOD LOAD FACTORS FOR CONTRAFLOW LANE BUSES (AM PEAK PERIOD)

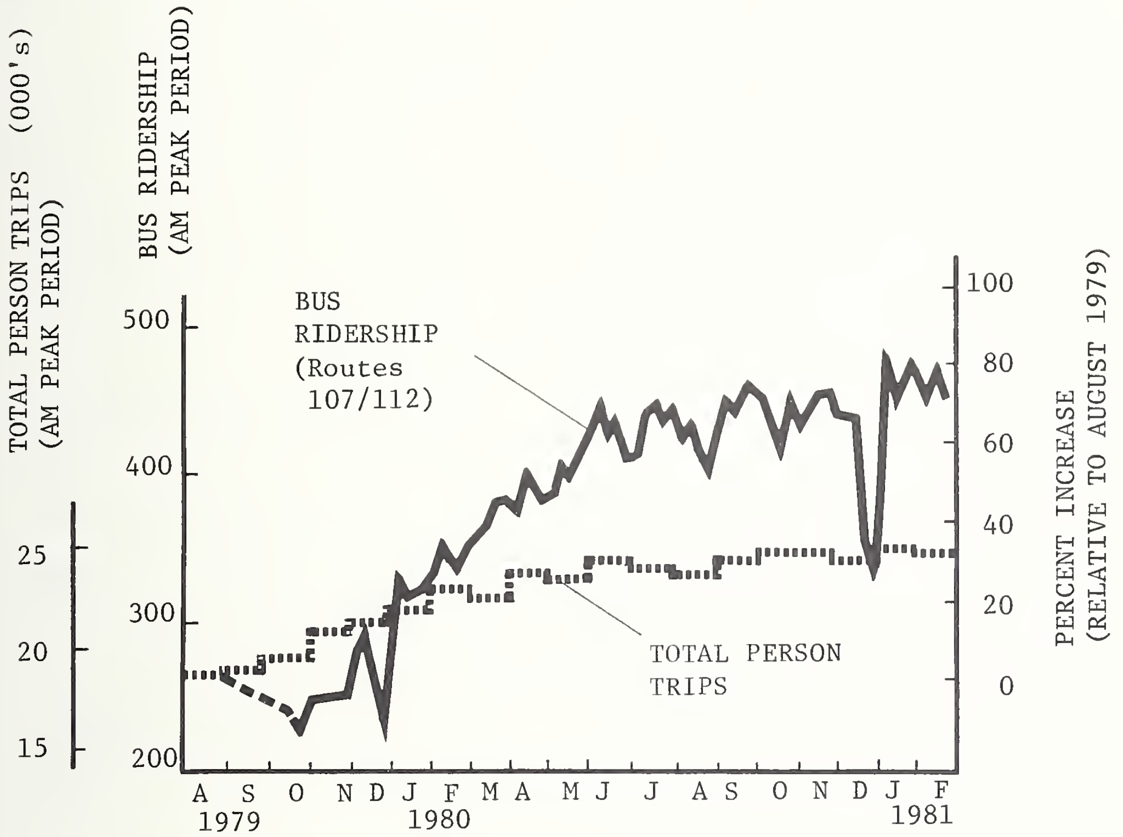

FIGURE 6-6. GROWTH IN RIDERSHIP ON BUS ROUTES 107/112
AND TOTAL NORTH FREEWAY PERSON TRIPS
(AM PEAK PERIOD)

of operation, so it is possible that ridership could have dropped to a level even lower than 225).

Beginning in November 1979, ridership on these two routes increased steadily at a rate of about seven new riders a week through April 1980 when North Shepherd Park-and-Ride service began. After April 1980, ridership continued to increase, but at a much slower rate (0.9 new riders per week), and eventually reached about 460 in February 1981. This represents a 75 percent increase relative to ridership levels existing prior to contraflow operation. Relative to ridership at the end of October (i.e., accounting for those riders attracted to new routes which began service when the contraflow lane opened), this represents a 100 percent increase.

Over the same period total person movement on the North Freeway increased by 31.7 percent. During this period no major service improvements were made on these two routes (additional bus trips were added only when demand exceeded supply), nor were there significant increases in the price of gasoline. Assuming, then, that in the absence of contraflow operation ridership on these two routes would have increased in proportion to total corridor travel, morning peak period ridership would have been 297 (225 base with a 31.7 percent increase) versus 460 with contraflow operation. This would suggest that the contraflow lane has led to a 54.9 percent increase in ridership on these two routes.

It should be noted, though, that because of the influence of the North Shepherd Park-and-Ride service which began in April 1980, this estimate of the influence of the contraflow lane on ridership is likely to be quite conservative. A more optimistic estimate would be obtained by assuming that if the North Shepherd Park-and-Ride service had not been implemented, ridership increases on Routes 107 and 112 would have continued to occur at the same rate after April 1980 rather than dropping from 7.0 to 0.9 new riders per week. Under this assumption, ridership would have reached a level of about 690 by the end of February 1981. Using the same assumptions as before, this would imply that the contraflow lane resulted in a 132.3 percent increase in ridership.

Assuming that the range of ridership increases resulting from contraflow operation for these two routes would also apply to the other three bus routes serving the North Freeway corridor, it would be possible to estimate a corresponding range for what total bus ridership would have been if bus service had been expanded without implementation of the contraflow lane. Using the average morning peak period ridership for February 1981 of about 3200, the corresponding ridership level without the contraflow lane would have ranged from 1,379 to 2,066. (See Figure 6-7). The former would imply that 56.9 percent of those riding the bus would not have done so without the contraflow lane, while the corresponding proportion for the latter would be 35.4 percent.

6.2.2 Park-and-Ride Lot Utilization

Usage of the park-and-ride lots closely paralleled the growth in bus patronage. The Champions Park-and-Ride lot (the only one available for the entire demonstration period), with a capacity of 330 vehicles, was relatively small and was used at or above capacity beginning in February 1980. Utilization of the Kuykendahl lot (the largest with a capacity of 1,300 vehicles) averaged about 300 cars per day when it first opened in January 1980 and increased to about 475 three weeks later. After one year, utilization averaged about 885 vehicles. By July 1981, the Kuykendahl lot was being used at or above capacity. Initial usage of the North Shepherd lot was about 400 vehicles per day. This increased quickly so that within six months, the lot was being used at or near capacity.

In October 1980, an inventory was made of vehicles parked in each of the three North Freeway corridor park-and-ride lots. These counts are summarized in Table 6-1 along with the corresponding number of morning passengers on the park-and-ride bus routes. As shown, the ratio of bus passengers to parked cars ranges from 1.20 to 1.29. Based on tabulations of the December 1980 survey of bus passengers, there were 1.29 bus riders for each car in the park-and-ride lots. The average reported occupancy of autos parked by bus passengers, though, was only 1.18 people. The difference in these two numbers

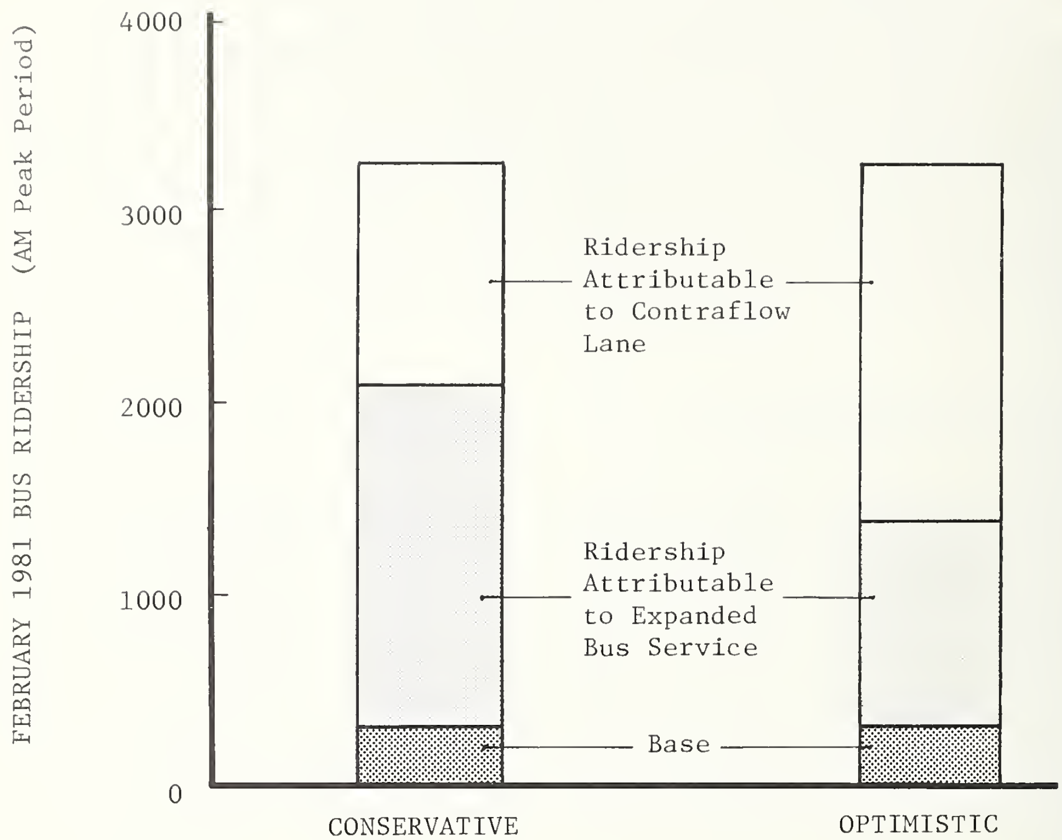

FIGURE 6-7. ESTIMATED INFLUENCE OF CONTRAFLOW LANE ON RIDERSHIP

TABLE 6-1. NORTH FREEWAY PARK-AND-RIDE VEHICLE COUNTS AND PATRONAGE OCTOBER 1980

	North Shepherd	Kuykendahl	Champions
Capacity (Vehicles)	750	1300	330
Daily vehicles	634	830	379[a]
AM Passengers	816	1031	454
Ratio (Passengers/Vehicles)	1.29	1.24	1.20

[a] Approximately 50 vehicles are illegally parked each day.

can probably be accounted for by those bus passengers who walked to the park-and-ride lots and those dropped off by someone not parking the car.

6.3 KEY FINDINGS

6.3.1 Improved Transit Services

In conjunction with the contraflow lane project, a number of other improvements to transit services available in the North Freeway corridor were also made. Prior to contraflow operation, there were no formal Park-and-Ride facilities serving the corridor. Transit services were limited to two private commuter bus routes operated by Oliver Bus Lines which provided about seven bus trips per peak period on the North Freeway. By May 1980, METRO was operating five bus routes (with buses contracted from private operators) and three park-and-ride lots (two permanent and one temporary). By May 1982, the average number of bus trips on the North Freeway during the morning peak period had increased to about 103.

6.3.2 Increased Ridership

In response to both these improved transit services and the contraflow lane, average morning peak period ridership increased from 265 immediately prior to contraflow operation (August 1979) to over 4,500 by May 1982--an increase of 1,600 percent.

6.3.3 Influence of Contraflow Lane

In addition to increased ridership, the average load factor for buses serving the North Freeway corridor also increased from .75 immediately prior to contraflow operation to .88 by May 1982. Since the service areas for many of the new routes instituted by METRO overlapped to some extent, this increase in average load factor suggests that at least some of the increase in ridership was the result of the travel time savings brought about by contraflow operation. Based on an analysis of ridership trends for the two

North Freeway routes existing prior to contraflow operation, it is estimated that between 35.4 and 56.9 percent of those using transit would not do so in the absence of the contraflow lane.

7. VANPOOL OPERATIONS AND CHARACTERISTICS

One unique aspect of this demonstration project was that vanpools as well as buses were permitted to use the North Freeway contraflow lane. This chapter describes the various vanpooling programs currently ongoing in the Houston region. The growth in the number of vanpools using the contraflow lane is also examined and compared with the overall increase in vanpooling Houston-wide. Finally, the characteristics of vanpools using the contraflow lane are discussed.

7.1 VANPOOLING IN HOUSTON

7.1.1 Employer Sponsored

Vanpooling was introduced to Houston in 1975 when Conoco, Inc. began a pilot program for its employees with 10 vans. Other large employers in the Houston area who began their own programs soon after Conoco include Aramco Services, Brown and Root, Hughes Tool Company, and Prudential Insurance Company in 1976; Gulf Oil and Mobil Oil in 1977; and Texas Instruments in 1978. By the summer of 1981, these 8 firms sponsored a total of 757 vans in the Houston area, with Brown and Root, employing 8,000 people, having the largest fleet of vans (309) in Houston. At that time, there were a total of 72 firms involved in vanpooling, representing 1700 vans out of a total of about 1800 vans in the Houston area.

7.1.2 VanShare

Complementing this established base of employer-sponsored vanpooling is the more recent growth of third-party vanpooling. Third-party vanpooling sponsored by the Metropolitan Transit Authority of Harris County (METRO) began officially in March 1980 when the CarShare Program (formed in 1975) received funding in the form of a National Ridesharing Demonstration grant to expand its rideshare marketing and matching activities to include vanpooling.[1] Prior to the actual grant approval, however, CarShare staff had already begun developing appropriate modifications for the expansion of CarShare to include VanShare. One of these changes was the installation of an on-line interactive computer system which could accommodate inter-company vanpool matching. In addition, promotional and administrative materials (i.e., rules and regulations, driver and passenger contracts, and criteria for vanpooling equipment and maintenance services) were developed.

Two major elements of the expanded VanShare program were third-party vanpooling and activity center coordination for organizing multi-employer (or inter-company) vanpools. With respect to third-party vanpooling, VanShare began offering 15-passenger vans to vanpool groups in June 1981 through Vanpool Services, Inc. (VSI), a subsidiary of Chrysler Corporation. VanShare staff members marketed the program and matched the groups of vanpoolers while VSI made all arrangements for providing the van, appropriate insurance, maintenance, etc. VSI recouped all of its costs through van passenger fares. The monthly fare for a 50 mile round trip was $65. This was about $10 to $20 higher than the cost of a similar trip in a corporate sponsored van since many companies which have their own programs could absorb the administrative costs or even subsidize the van operating expense as an employee benefit.

Activity center rideshare marketing had always been an element of the CarShare program and was expanded to include vanpool promotion and matching. The three largest non-downtown activity centers (Greenway Plaza, City Post Oak, and Texas Medical Center) each had an activity center ridesharing coordinator and a remote terminal linked to the ridesharing computer at METRO's administrative offices. When VSI became involved in the VanShare program, multi-employer matching services were initiated at several moderately-sized activity centers as well.

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[1]For more details on all aspects of METRO's VanShare program, see the forthcoming evaluation report of Houston's National Ridesharing Demonstration program.

7.1.3 Owner-Operated

As of July 1981, there were ten owner-operated vanpools in the Houston area, more than half of which used the North Freeway contraflow lane. Except for the groups which needed to become certified for use of the contraflow lane, there was no direct connection between the formation of these vanpools and VanShare. Essentially, some enterprising people who owned vans found groups of riders willing to pay to commute by vanpool.

7.1.4 Community-Based

Community-based vanpooling is similar to employer-based or activity center-based vanpooling except that the common location for marketing to potential program applicants is at the home rather that work end of the commuting trip. The one community-based vanpool program currently operating in the Houston area is run by a third-party provider, The Woodlands Commuter Service. The residential developers in The Woodlands (which is located adjacent to the North Freeway about 35 miles from downtown Houston) market their houses by offering this semi-public transportation for commuting. Started in September 1976, this program now has 34 vans which originate in The Woodlands and go to employment locations in Houston; there are also four vans which operate from Houston to the Mitchell Energy and Development Company which is located in The Woodlands.

7.2 GROWTH IN CONTRAFLOW LANE VAN USE

The growth in vanpool ridership on the North Freeway contraflow lane during the first 33 months of operation is presented in Figure 7-1. For purposes of comparison, the growth in bus ridership during this same period is also presented. As shown, during the first week of contraflow operation, vanpool ridership during the morning peak period averaged 773, and that for bus averaged 404. While the initial level of vanpool ridership was nearly twice that of bus, vanpool ridership increased at a somewhat slower rate, so that by December 1979, bus ridership had reached the same level as vanpool

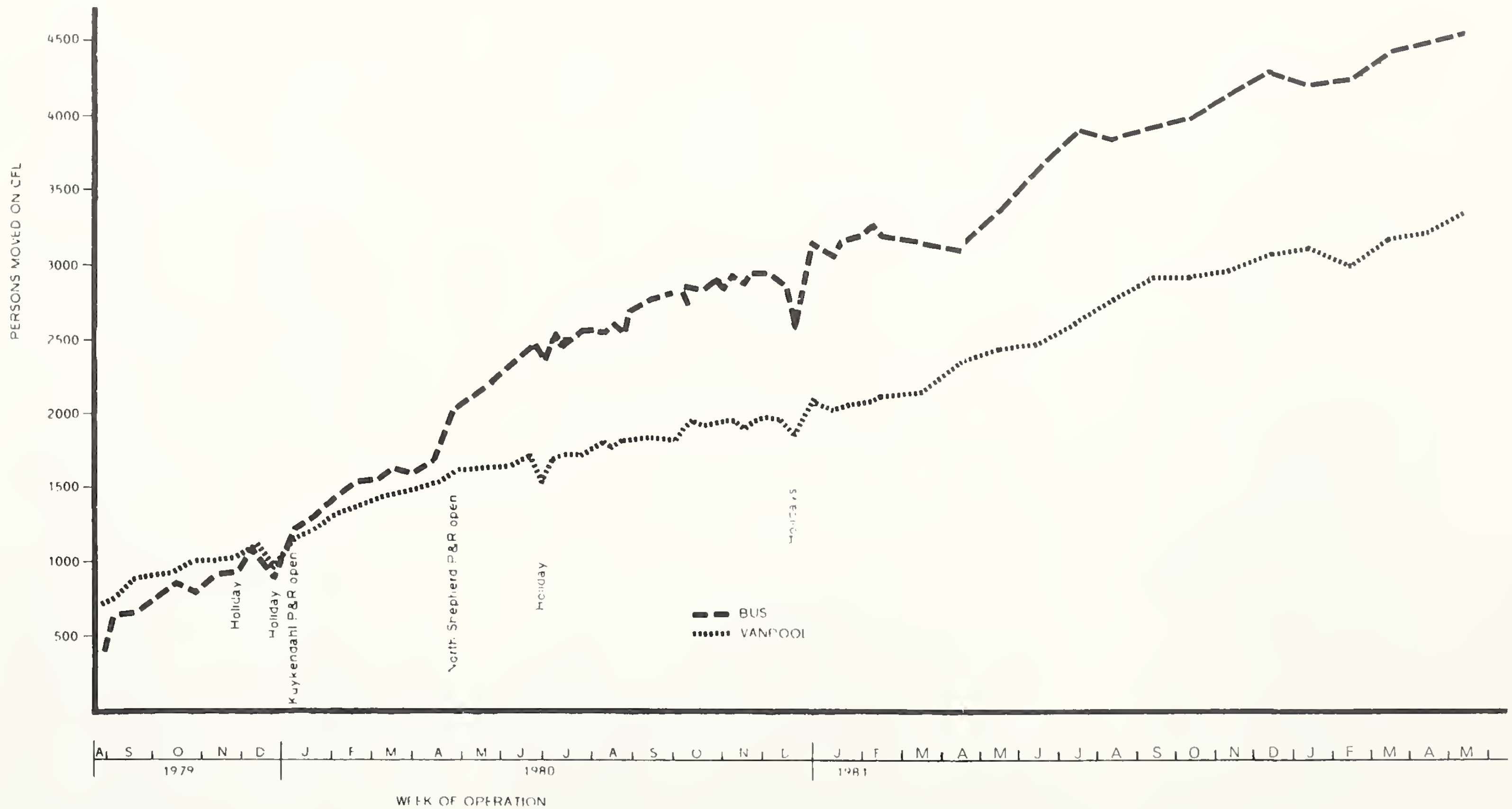

FIGURE 7-1. GROWTH IN VANPOOL RIDERSHIP RELATIVE TO TRANSIT RIDERSHIP

ridership (about 1100). Subsequently, bus ridership exceeded vanpool ridership and continued to grow at a faster rate. By May 1982, vanpool ridership averaged 3,280 during the morning peak period, while bus ridership had reached 4,520.

With respect to the growth in vanpool ridership shown in Figure 7-1, several points should be noted. First, unlike bus ridership, there were no counts available for vanpool ridership prior to contraflow operation. From the surveys administered to vanpool drivers in December 1980, though, the formation date of those vanpools surveyed could be determined. This information is presented in Figures 7-2 and 7-3 as the number of vanpools formed in a given month and the cumulative number of vanpools for the 2-year period from January 1978 through December 1980, respectively. As shown in Figure 7-2, the vanpool formation rate, while showing some minor fluctuations, was relatively constant between January 1978 and June 1979, averaging about 2.7 per month. In July and August of 1979, though, 31 vanpools (44 percent of all vanpools existing at the time the contraflow lane first opened) were formed. Once contraflow operation began, the vanpool formation rate dropped somewhat, from an average of 15.5 per month for July and August of 1979 to 7.9 per month for the period from September 1979 through December 1980. This would suggest that the decision to allow vanpools on the contraflow lane, which was made in the spring of 1979, stimulated the formation of a number of vanpools immediately prior to the opening of the contraflow lane.

It should be noted that while the vanpool formation rate after contraflow operation (7.9 vanpools per month) was only about half of that for July and August of 1979, it was still three times that observed during the period between January 1978 and June 1979 (2.7 vanpools per month). On the surface, this would suggest that the contraflow lane had a positive impact on vanpooling. In addition to implementation of the contraflow lane, though, there were a number of other vanpooling-related activities ongoing in Houston. In order to gain insight into the influence of the contraflow lane on the level of vanpooling in the North Freeway corridor relative to these

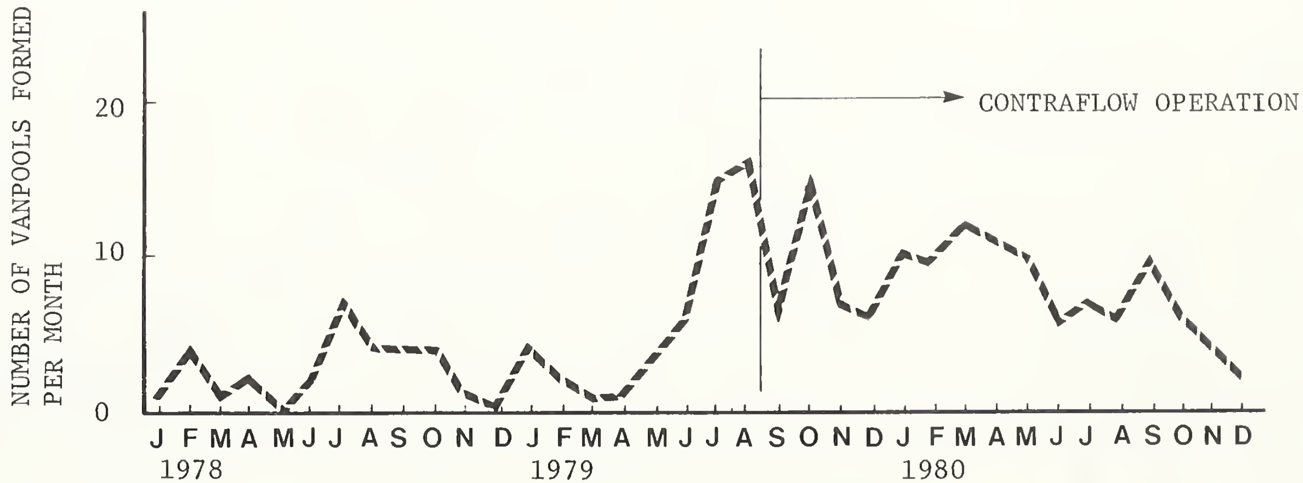

FIGURE 7-2. VANPOOL FORMATION BY MONTH

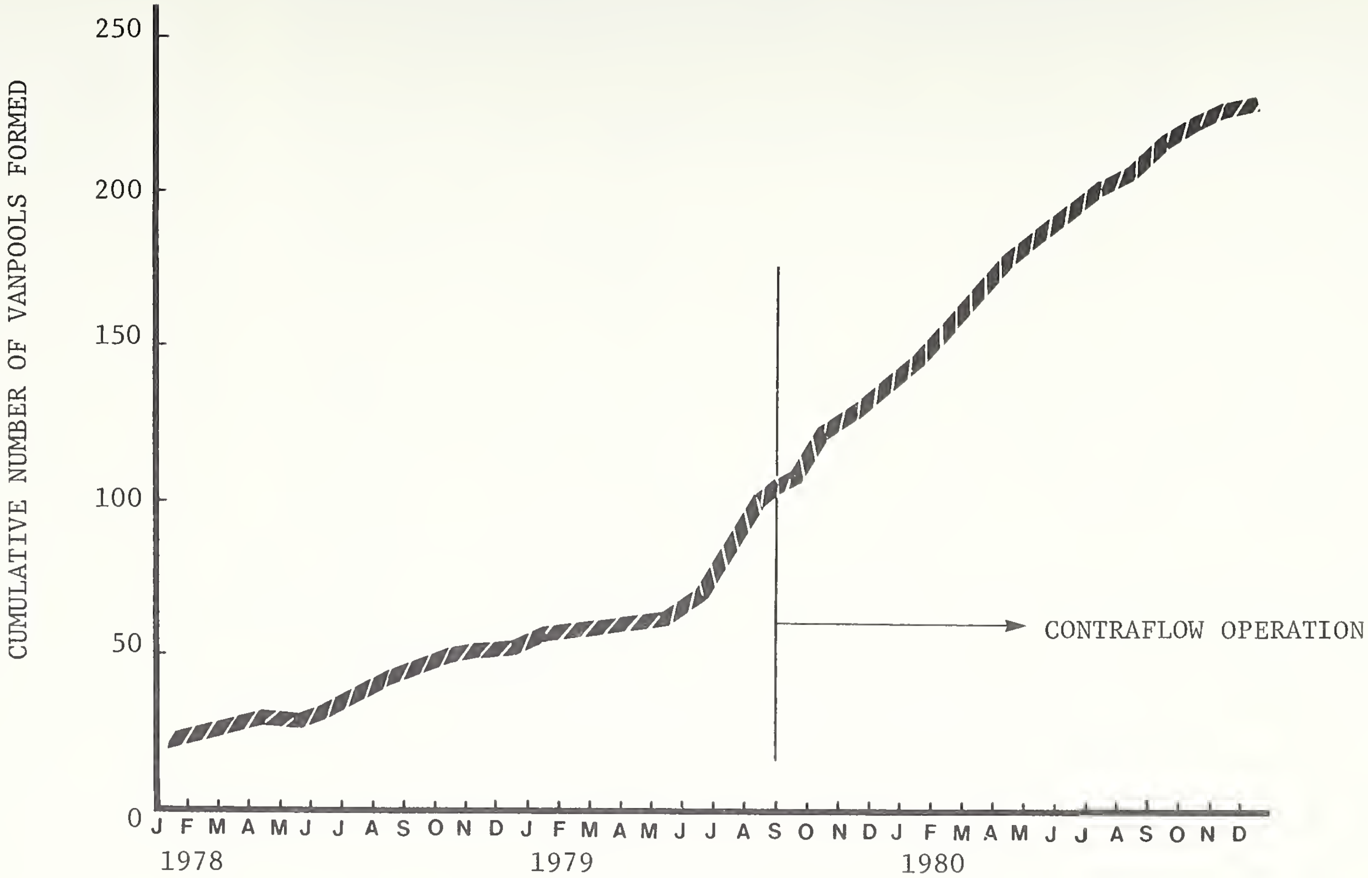

FIGURE 7-3. CUMULATIVE NUMBER OF VANPOOLS

other activities, then, it would be useful to put this increase into the perspective of increased vanpooling throughout the entire Houston region.

Figure 7-4 presents the number of vanpools in existence at the end of each year between 1976 and 1980, and in July of 1981 and 1982, both Houston-wide and in the North Freeway corridor. As shown, while the number of vanpools in the North Freeway corridor increased between December 1978 and December 1979 from 50 to 133 (a 166 percent increase), the number of vanpools Houston-wide increased from 261 to 861 during this same period--an increase of 230 percent. By July 1981, the number of vanpools in the Houston area had increased to 1751, while the number of vanpools using the contraflow lane had grown to 275, which represent increases of 103 and 107 percent respectively relative to December 1979. As shown in Figure 7-5, the percent of all Houston vanpools travelling in the North Freeway corridor was about 18 percent at the end of 1978. One year later (after the contraflow lane had been in operation for four months), this percentage dropped to about 15 percent and remained at about that level through July 1981. Between July 1981 and July 1982, vanpooling in the North Freeway corridor increased at a faster rate than vanpooling Houston-wide. By July 1982, the proportion of all Houston vanpools travelling in the North Freeway corridor was about 19 percent, which was only slightly higher than the proportion existing prior to contraflow operation. Assuming that the increase of work travel in the North Freeway corridor was comparable with other areas in the region, these results would suggest that at best the increase in vanpool ridership on the contraflow lane has matched the overall growth of vanpooling in Houston.

If all else were equal, a higher rate of vanpooling would have been expected in the North Freeway corridor relative to other areas as a result of the travel time savings realized by vanpools using the contraflow lane. Unlike other areas, though, the North Freeway corridor was also the focus of a very intensive transit improvement program beginning at the same time that the contraflow lane was opened. As a result, it is quite likely that many people who might have considered vanpooling instead chose transit as their mode to work. This, in turn, would suggest that transit service in the North Freeway

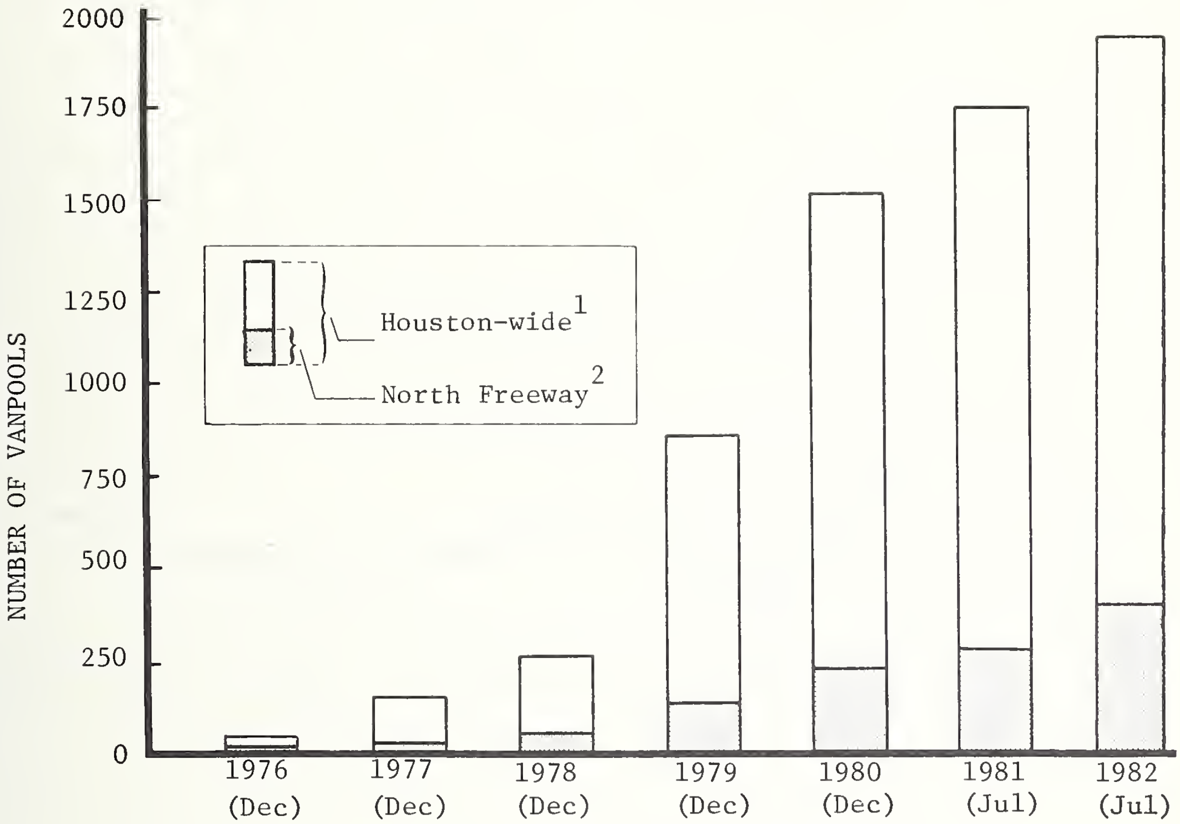

FIGURE 7-4. GROWTH OF VANPOOLING: HOUSTON VERSUS NORTH FREEWAY CORRIDOR

[1] Texas Transportation Institute, "The Texas Vanpool Census, July 1981 and 1982.

[2] Formation dates from 12/81 Survey of Vanpool Drivers, and Contraflow Lane Vanpool Counts.

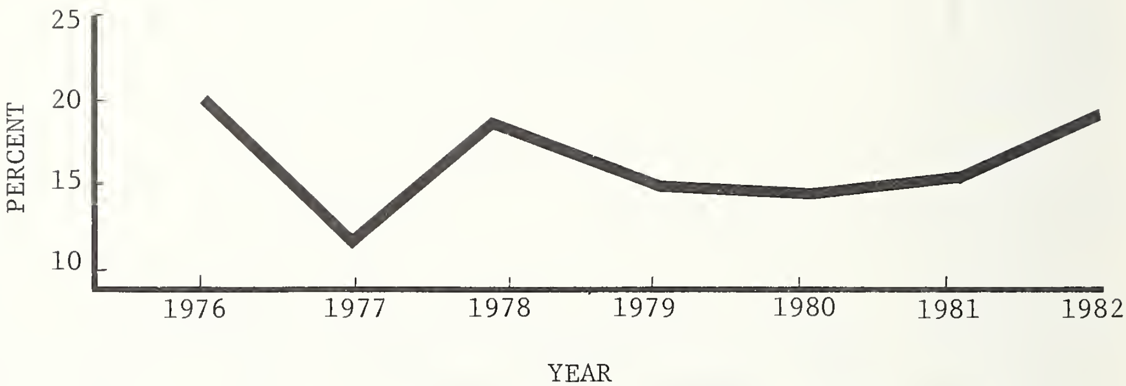

FIGURE 7-5. PERCENT OF HOUSTON'S VANPOOLS IN NORTH FREEWAY CORRIDOR

corridor was more attractive than vanpooling to those commuters either new to the Houston area or switching from auto.

If, in fact, bus was competing with vanpool, any major change in bus supply would be expected to be reflected in the trend of vanpool ridership. With the exception of the new routes added when the contraflow lane initially opened, two major changes in bus supply characteristics can be identified:

1. Opening of the North Shepherd Park-and-Ride lot in April 1980, which increased the number of bus trips on the contraflow lane by about a third; and

2. Utilization of the North Freeway corridor Park-and-Ride facilities at or above capacity, which began to occur in February 1981.

The general trend in AM peak period vanpool ridership in relationship to these two changes in bus supply characteristics is presented in Figure 7-6. As shown, within one month of the beginning of North Shepherd Park-and-Ride service, the rate of increase in vanpool ridership decreased from an average of about 93 to 63 new vanpoolers per month. At about the same time that utilization of the North Shephard Park-and-Ride lot began to reach capacity, the rate of increase in vanpool ridership increased from an average of 63 to about 102 new vanpoolers per month. While these results are by no means conclusive, they do tend to support the notion that transit and vanpooling are to a certain extent competing as alternatives to auto in the North Freeway corridor.

7.3 CHARACTERISTICS OF VANPOOLS

7.3.1 Formation

Table 7-1 summarizes information related to the formation of vanpools using the North Freeway contraflow lane. Results are based on a survey of North Freeway vanpool drivers conducted in December 1980. As shown, most (73.9 percent) of the 228 vanpools travelling the contraflow lane at the time of the survey were employer-sponsored. An additional 20.6 percent were

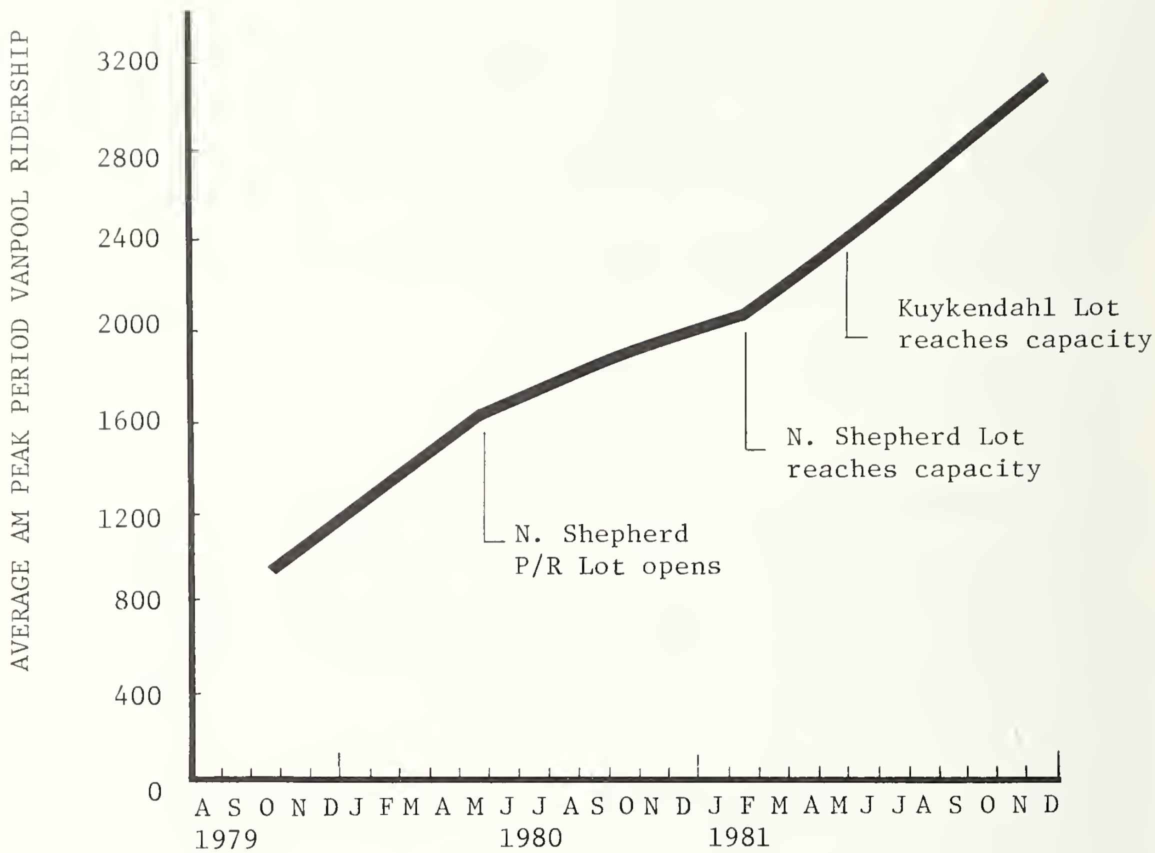

FIGURE 7-6. VANPOOL RIDERSHIP RELATIVE TO BUS SUPPLY CHARACTERISTICS

TABLE 7-1. VANPOOL FORMATION AND TURNOVER BY TYPE OF OWNERSHIP/LEASING ARRANGEMENT

	Type of Ownership			
	Employer-Sponsored	Driver-Owned	Third-Party	Total
Percent of All Vanpools	73.9%	5.5%	20.6%	100%
Vanpool First Organized by:				
Employer	70.7%	11.1%	19.5%	55.2%
Driver	26.4	77.8	14.6	27.4
Residential Developer	--	--	56.1	11.9
Other	2.9	11.1	9.8	5.5
Average Age of Vanpool (as of 10/80)	18 mos.	36 mos.	22 mos.	20 mos.
Vanpool Size (# people)				
When organized	10.9	6.0	11.0	10.7
Current (10/80)	11.7	10.5	11.9	11.8
Turnover (# people)				
Dropping out	3.95 (.22/mo.)	9.5 (.26/mo.)	6.35 (.29/mo.)	4.53 (.23/mo.)
Joining	4.74 (.26/mo.)	14.0 (.39/mo.)	7.29 (.33/mo.)	5.52 (.28/mo.)

third-party vanpools, with the remaining 5.5 percent categorized as driver-owned (including two vanpools which were owned jointly by all members of the vanpool).

Not surprisingly, most of the employer-sponsored vanpools (70.7 percent) were first organized by the employer, although 26.4 percent were formed by the driver. Over half of the third-party vanpools (56.1 percent) were organized by The Woodlands Commuter Service, which is a community-based third-party vanpooling service established by the developers of The Woodlands, a residential area about 35 miles north of downtown Houston.

At the time of the survey (December 1980), the average length of time that vanpools travelling the North Freeway had been in operation was 20 months. The average age was greatest for driver-owned vanpools (36 months), which included one vanpool that was reported to have been formed in 1961. The average length of time in operation was shortest for employer-sponsored vanpools (18 months), while third-party vanpools had been in operation for an average of 22 months.

The average number of people in a vanpool when originally formed was 10.7. At the time of the survey (i.e., after an average of 20 months of operation), this had increased to 11.8. In terms of turnover, the average vanpoool lost 4.53 riders (an average of .23 per month of operation), and gained 5.52 riders (.28 per month). Turnover was lowest among employer-sponsored vanpools (loosing an average of .22 riders per month and gaining an average of .26 riders per month) and highest for third-party vanpools (losing an average of .29 riders per month and gaining an average of .33 riders per month).

7.3.2 Vanpool Fares and Parking Costs

As shown in Table 7-2, the average monthly fare for vanpools using the contraflow lane was $39.44. Fares were highest for third-party vanpools ($55.57) and lowest for employer-sponsored vans ($34.41). Not surprisingly, in practically all of the employer sponsored vanpools, fares were set by the employer, while it was the driver who set fares in all driver-owned vanpools.

TABLE 7-2. VANPOOL FARES AND PARKING COSTS

	Type of Ownership			
	Employer-Sponsored	Driver-Owned	Third-Party	Total
Percent of All Vanpools	73.9%	5.5%	20.6%	100%
Average Fare	$34.41	$46.59	$55.57	$39.44
Fare Set By:				
Employer	98.0%	--	19.5%	74.1%
Driver	1.0	100.0%	2.4	6.0
Third Party	--	--	68.3	14.4
Other	1.0	--	9.8	5.5
Parking Subsidized by Employer	71.8%	--	22.5%	55.8%
Average Daily Parking Cost (if not subsidized)	$2.81	$.99	$2.55	$2.59
Guaranteed or Preferential Parking Spot	87.7%	--	47.5%	70.9%

For third-party vanpools, fares were set primarily by the third party (68.3 percent) and to a lesser extent by employers (19.5 percent).

The relatively low fare for employer-sponsored vans can be accounted for by a number of factors. First, a number of employers provided subsidies for vanpoolers. In the vanpool passenger survey, for example, 27.1 percent of all vanpoolers surveyed indicated that their employer contributed part of their monthly vanpool fare. Assuming that these responses were all from passengers in employer-sponsored vans, which represent 73.9 percent of all vanpools, this would imply that 36.7 percent of employer-sponsored vanpools were subsidized to some extent by the employer. Second, employer-sponsored vanpools have a somewhat shorter average trip length relative to driver-owned and third-party vanpools. (The one-way drive alone distance reported by drivers of employer-sponsored vans was 27.0 miles while those for driver-owned and third-party vanpools were 32.9 and 33.7 miles respectively.) One would expect that the higher operating costs associated with longer trip lengths would be reflected in fares. Third, for 71.8 percent of employer-sponsored vanpools, parking costs were subsidized by the employer, while none of the driver-owned vanpools and only 22.5 percent of third-party vanpools benefited from employer-subsidized parking.

7.3.3 Driver Responsibilities and Incentives

Table 7-3 summarizes the responsibilities and incentives of vanpool drivers for each of the three ownership/leasing arrangements. Not surprisingly, drivers assumed all responsibilities associated with the operation of the vanpool in driver-owned vanpools. In third-party vanpools, nearly all drivers were responsible for fare collection (97.6 percent) and gas purchases (95.1 percent). In employer-sponsored vanpools, though, only 61.0 percent of the drivers were responsible for fare collection, and 80.2 percent for gas purchases. The former could reflect the use of payroll deductions on the part of the employer as a means of fare collection, while the latter might be attributable to some of sort of centralized maintenance and service facility established by some employers. The responsibility of

TABLE 7-3. VANPOOL DRIVER RESPONSIBILITIES AND INCENTIVES

	Type of Ownership		
	Employer-Sponsored	Driver-Owned	Third-Party
Percent of All Vanpools	73.9%	5.5%	20.6%
Driver Responsibilities			
Fare Collection	61.0%	100.0%	97.6%
Gas Purchase	80.1	100.0	95.1
Cleaning	87.2	100.0	61.0
Arranging Maintenance	72.3	100.0	78.1
Recruiting New Passengers	73.8	100.0	29.3
Securing Back-up Drivers	91.5	100.0	92.7
Driver Benefits			
Rides Free	89.9%	88.9%	97.6%
Retains Part of Fares	8.6	88.9	2.4
Free use of Van	59.4	100.0	14.6
Free Miles/month			
Range	50-524 miles	--	50-200 miles
Mean	171.5 mi.	--	112.5 mi.
Cents/Mi. After Free Miles			
Range	5-30 cents	--	10-20 cents
Mean	15.0¢	--	16.2¢

recruiting new passengers was borne by a much higher proportion of drivers in employer-sponsored vanpools relative to third-party vanpools (73.8 versus 29.3 percent).

In terms of driver benefits, nearly all (97.6 percent) drivers in third-party vanpools and most (89.9 percent) drivers in employer-sponsored vanpools did not pay a fare. In both cases, those drivers who did pay a fare typically were allowed to retain fares from the tenth and eleventh passengers. In terms of personal use of the van, 59.4 percent of the drivers in employer-sponsored vanpools were allowed free use of the van up to an average of 171.5 miles per month, while only 14.6 percent of drivers in third-party vans were permitted free use (up to an average of 112.5 miles per month). The average cost of personal use after the allowed free mileage was 15.0 cents per mile for employer-sponsored vanpools and 16.2 cents per mile for third-party vanpools.

7.3.4 Vanpool Reliability

A number of measures related to the reliability of vanpool for commuting are presented in Table 7-4. As shown, in situations where the regular van was not available, 76.5 percent of all vanpools had a back-up van available. Back-up vans were available for 92.7 percent of third-party vanpools. For driver-owned vanpools, the availability of a back-up van was much more limited (11.1 percent of driver-owned vanpools). When the regular van was not available, 55.6 percent of driver-owned vanpools had alternative arrangements to get to work by means of several carpools, while in 22.2 percent of these vanpools it was up to the individual to make alternate arrangements. Back-up vans were available for 77.7 percent of employer-sponsored vanpools. For 9.4 percent of employer-sponsored vanpools, the alternate mode was several carpools, while for an additional 7.2 percent, it was up to the individual to make alternate arrangements.

In terms of on-time performance, 77.0 percent of vanpool passengers surveyed indicated that they were picked up on time in the morning, while an additional 20.4 percent were picked up within five minutes of their scheduled

TABLE 7-4. VANPOOL RELIABILITY

	Type of Ownership			
	Employer-Sponsored	Driver-Owned	Third-Party	Total
<u>Mode When Van Not Available</u>				
Back-up Van	77.7%	11.1%	92.7%	76.5%
Several Carpools	9.4	55.6	2.4	11.5
Bus	0.7	11.1	--	1.0
Up to Individual	7.2	22.2	4.9	7.5
Other	5.0	--	--	3.5
<u>Number of Back-Up Drivers</u>	2.06	1.6	1.7	2.0
<u>Minutes Late This AM</u>				
(Percent of Vanpool Passengers)				
On Time				77.0%
0-5 minutes late				20.4
5-10 minutes late				2.2
10 minutes late				0.4
<u>Minutes Late This PM</u>				
(Percent of Vanpool Passengers)				
On Time				82.8%
0-5 minutes late				14.8
5-10 minutes late				2.1
10 minutes late				0.4

meeting time. Only 0.4 percent reported that their vanpool was more than 10 minutes late. Similar results were reported for being picked up in the afternoon.

7.4 KEY FINDINGS

7.4.1 Increase in Vanpooling

Average peak period vanpool ridership on the contraflow lane increased from about 770 during the first week of operation to 3,280 by May 1982. While this represents an increase of 326 percent, it is considerably less than the 1,600 percent increase observed for bus ridership.

In terms of Houston-wide vanpooling, 18 percent of the region's vanpools were operating in the North Freeway corridor prior to contraflow operation. During the first two years of operation, vanpooling region-wide grew at a faster rate than in the North Freeway corridor, with the result that only about 15 percent of Houston's vanpools were operating in the North Freeway corridor during that period. Between July 1981 and July 1982, though, growth in vanpooling in the North Freeway corridor exceeded that Houston-wide, and by July 1982, 19 percent of Houston's vanpools were operating in the North Freeway corridor.

7.4.2 Relationship Between Vanpooling and Bus Ridership

If all else were equal, a higher rate of vanpooling would have been expected in the North Freeway corridor relative to other areas as a result of the travel time savings realized by vanpools using the contraflow lane. Unlike other areas, though, the North Freeway corridor was also the focus of a very intensive transit improvement program. This would suggest that transit was in effect competing with vanpooling in the North Freeway corridor, an hypothesis which is supported by the relationship between vanpool ridership and major changes in bus supply characteristics.

Although the proportion of all vanpools in the Houston area operating in the North Freeway corridor after nearly three years of contraflow operation was the same as that in December 1978, it is quite likely that if vanpools had not been permitted to use the contraflow lane, the competitive relationship between vanpooling and transit would had led to a much lower level of vanpooling in the North Freeway corridor. Further, between July 1981 and July 1982, during which time park-and-ride facilities reached capacity and average load factors on buses rose to .88, vanpooling in the North Freeway corridor increased at a higher rate than in other areas in the Houston region. If bus services continue to operate at or near capacity, it is likely that the growth in vanpooling on the North Freeway will continue to exceed that regionwide.

8. CHARACTERISTICS OF NORTH FREEWAY TRAVELLERS

One approach for identifying those factors which have led to the increases in bus ridership and vanpooling on the North Freeway is to examine the differences between the characteristics of those choosing to travel by bus and vanpool and those choosing to travel by auto. This chapter discusses these differences in terms of both the type of trip being made and traveller characteristics. Particular attention is given to situational considerations which would limit the extent to which travellers could take advantage of the contraflow lane and other transportation improvements in the North Freeway corridor (i.e., residential and employment location, occupation, auto availability, etc.). In addition, the perceptions of and attitudes towards the contraflow lane among bus riders and vanpoolers are presented. The analysis presented in this chapter is based on the results of a series of travel surveys administered to North Freeway travellers in December 1980.[1]

8.1 TRIP CHARACTERISTICS

8.1.1 Purpose, Length, Origin and Destination

Table 8-1 presents average trip lengths and the distributions of trip purpose, origin, and destination for morning peak direction North Freeway travellers. Results are presented separately for auto drivers (single and multiple occupant), auto passengers, bus riders, and vanpoolers. As shown, the vast majority of those using the North Freeway were travelling to work. The highest proportions of work travel were observed among vanpoolers (100 percent) and bus riders (99.5 percent), while the lowest proportions were observed among carpoolers (93.4 percent for drivers of multiple occupant autos and 94.8 percent for auto passengers).

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[1]Documentation of these surveys is provided in Appendix A.

TABLE 8-1. TRIP ORIGIN, DESTINATION, AND PURPOSE OF PEAK PERIOD, PEAK DIRECTION NORTH FREEWAY TRAVELLERS

	Auto Drivers				
	Single Occupant	Multiple Occupant	Auto Passengers	Bus Riders	Vanpoolers
Origin					
Between CBD & CLF entrance	6.0%	1.4%	2.6%	4.4%	0.0%
0-5 miles, beyond CFL	27.3	15.1	19.7	20.8	18.3
5-10 miles, beyond CFL	12.0	26.0	22.4	27.4	16.5
> 10 miles, beyond CFL	54.7	57.5	55.3	47.4	65.3
Destination					
Downtown	29.3%	48.5%	66.7%	95.5%	74.9%
Texas Med. Center	2.3	4.4	1.4	1.2	1.8
Galleria	13.1	7.4	8.7	0.8	1.2
Greenway Plaza	6.9	4.4	4.3	0.9	6.2
Other	48.4	35.3	18.9	1.0	15.2
Purpose					
Work	96.1%	93.4%	94.8%	99.5%	100.0%
Other	3.9	6.6	5.2	0.5	0.0
Trip Length	25.4 mi		26.0 mi	24.2 mi	30.5 mi
SAMPLE SIZE	154	76	78	864	1997

In terms of trip destination, over 95 percent of those using bus were travelling to the Central Business District (CBD), which reflects the radial orientation of express bus routes serving the North Freeway corridor, with most routes terminating in the CBD. While access by bus to areas outside the CBD was available by transferring to local bus service, it would appear that this option was not particularly attractive, since only 2 percent of those bus riders surveyed reported transferring to another bus as the means of getting to their ultimate destination.

Nearly three-quarters of those in vanpools had destinations within the CBD. To a large extent this probably reflects the access and egress restrictions of the contraflow lane relative to the normal freeway lanes (i.e., anyone using the lane must travel to the downtown area). Among auto users, only 29.3 percent of those driving alone had destinations within the downtown area, while two-thirds of auto passengers were travelling to the CBD. This higher proportion of auto passengers probably reflects the increased opportunities for ridesharing associated with the high level of employment concentrated within the CBD.

Trip origins for vanpools and bus riders using the contraflow lane and those auto users entering the North Freeway at or north of the contraflow lane entrance at North Shepherd are also presented in Table 8-1. As shown, nearly two-thirds of all vanpools originated beyond ten miles of the contraflow lane entrance (the figures shown in Table 8-1 represent vanpool drivers). Over half of all auto users also began their trip beyond ten miles of the contraflow lane entrance. On the other hand, the majority of bus riders (52.6 percent) began their trips within ten miles of the contraflow lane.

8.1.2 Frequency of Bus Use

Frequency of bus use (days per week) is presented in Table 8-2. As shown, a vast majority of those surveyed (81.4 percent) rode the bus five days a week. It should be noted, though, that since these more frequent riders were more likely to have been included in the survey, this proportion is somewhat biased. For example, the probability of surveying someone riding the

TABLE 8-2. FREQUENCY OF BUS USE

FREQUENCY (DAYS/WEEK)	% of Riders Surveyed	% of All Travellers Using Bus At Least 1 Day/Week
5	81.4%	65.8%
4	8.6	8.7
3	3.6	4.9
2	1.6	3.2
1	4.3	17.4

bus five days a week would have been five times as great as that for someone riding the bus only one day a week. If frequency of bus use is expressed in terms of all travellers using the bus at least one day a week (also shown in Table 6-2), the proportion using the bus five days a week would be 65.8 percent.

8.1.3 Former Mode of Bus Riders and Vanpoolers

The former travel modes of those bus riders who were travelling on the North Freeway prior to the implementation of the contraflow lane are presented in Table 8-3. Also presented are the morning peak period mode shares for all North Freeway travellers immediately prior to contraflow operation. Not surprisingly, a greater proportion of current bus riders were also using the bus prior to contraflow operation relative to the proportion of all North Freeway using bus at that time (14.0 versus 2.3 percent). Aside from this difference, though, the distribution of former modes of bus riders is for the most part proportional to the mode shares of all North Freeway travellers prior to contraflow operation.

The former modes of travel used by vanpool drivers and vanpool passengers who were travelling on the North Freeway prior to contraflow operation are also presented in Table 8-3. As shown, a disproportionate number of vanpoolers formerly carpooled or rode the bus before joining a vanpool. For example, while the average drive alone mode share for all North Freeway travellers was 56.5 percent prior to contraflow operation, only 25.4 percent of vanpool drivers and 35.7 percent of vanpool passengers surveyed in December 1980 indicated that they formerly drove alone. On the other hand, while the average carpool mode share among all North Freeway travellers was 36.9 percent, 64.4 percent of all vanpool drivers and 49.1 percent of vanpool passengers indicated carpool as their former mode. For bus, the average North Freeway mode share was 2.3 percent prior to contraflow operation, while the bus shares of former modes for vanpool drivers and vanpool passegers were 8.5 and 14.4 percent, respectively. These results would suggest that vanpooling is competing with both bus and carpooling as an alternative to driving alone.

TABLE 8-3. FORMER MODES OF BUS RIDERS AND VANPOOLERS PRIOR TO CONTRAFLOW OPERATION

Mode	North Freeway AM Peak Mode Shares (1979)	Former Mode of:[1] Bus Riders	Vanpool Drivers	Vanpool Passengers
Drive Alone	.565	.494	.254	.357
Carpool	.369	.344	.644	.491
Bus	.023	.140	.085	.144
Vanpool	.043	.019	--	--
Other	--	.004	.017	.007
SAMPLE SIZE		864	202	1,795

[1] Former mode is defined as the mode of travel for the same trip prior to contraflow operation. The distributions of former modes presented here, then, represent only those travellers making the same trip prior to contraflow operation. At the time that the surveys were administered, 34.4 percent of bus riders, 10.6 percent of vanpool drivers and 18.3 percent of vanpool passengers reported that they did not make the same trip prior to contraflow operation.

8.1.4 Access Mode and Distance (Bus and Vanpool)

The distributions of access mode and access distance for bus riders are presented in Table 8-4. As shown, nearly 85 percent of all riders utilized park-and-ride lots in order to access North Freeway corridor buses, while only 3.7 percent used walk access. While this is not surprising in view of the relatively low density of the areas served by the North Freeway and the express-nature of the bus routes serving this area, it does emphasize the importance of the park-and-ride facilities as a factor contributing to the increase in bus ridership over the course of the demonstration. In addition to park-and-ride and walk, 12.2 percent of those bus riders surveyed indicated kiss-and-ride as their mode of access. Of these, about two-thirds were dropped off by another person continuing on to another destination, while the remaining one-third were dropped off by someone making a special trip.

In terms of access distance, nearly two-thirds of those riding the North Freeway buses resided within five miles of where they met the bus, and over 90 percent resided within ten miles. The distribution of access distance by access mode is presented in Figure 8-1. Not surprisingly, all walk access occurred within five miles.[1] With respect to the two auto access modes, 62.0 percent of access by park-and-ride and 77.0 percent of access by kiss-and-ride occurred within five miles.

The distributions of access mode and access distance for vanpool passengers are also presented in Table 8-4. As shown, only 18.9 percent of all vanpoolers were picked up at home, which may indicate that to a large extent vanpoolers were picked up at one or more common meeting points. In terms of access mode for those not picked up at home, drive alone was most commonly used (60.7 percent), while 19.7 percent carpooled, and the remaining 11.3 percent either walked or bicycled to meet their vanpool. Access distance among vanpool passengers was relatively short, averaging 3.7 miles (versus 5.1 miles for bus). This most likely reflects the much greater flexibility in establishing a vanpool meeting point relative to bus, which for the most part was limited to the three park-and-ride lots.

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[1]More specifically, 95 percent of all walk access occurred within one mile.

TABLE 8-4. ACCESS MODE AND DISTANCE

	Bus Riders	All Vanpool Passengers	Vanpool Passengers Not Picked up at Home
Access Mode			
Picked up at Home	(NA)	18.9%	--
Park/Ride (Drive Alone)	65.8	49.2	60.7%
Park/Ride (Carpool)	18.2	16.0	19.7
Kiss/Ride (Dropped Off)[1]	8.4	2.5	3.1
Kiss/Ride (Special Trip)[2]	3.8	4.2	5.2
Walk/Bicycle	3.7	9.2	11.3
Access Distance			
0-1 miles	16.6%	48.5%	36.5%
1-2 "	14.6	13.6	16.7
2-3 "	13.9	10.9	13.4
3-5 "	20.5	12.6	15.5
5-10 "	26.6	10.7	13.2
10-15 "	6.0	2.1	2.6
15-20 "	0.9	0.7	0.9
20-25 "	0.8	0.3	0.4
25-30 "	0.5	0.2	0.2
30 "	0.1	0.5	0.6
MEAN	5.1 miles	3.0 miles	3.7 miles
SAMPLE SIZE	864	1,795	1,456

1 Bus passenger dropped off by another person continuing on to another destination other than home.

2 Bus passengers dropped off by another person whose sole purpose for making the trip was to provide access to the bus.

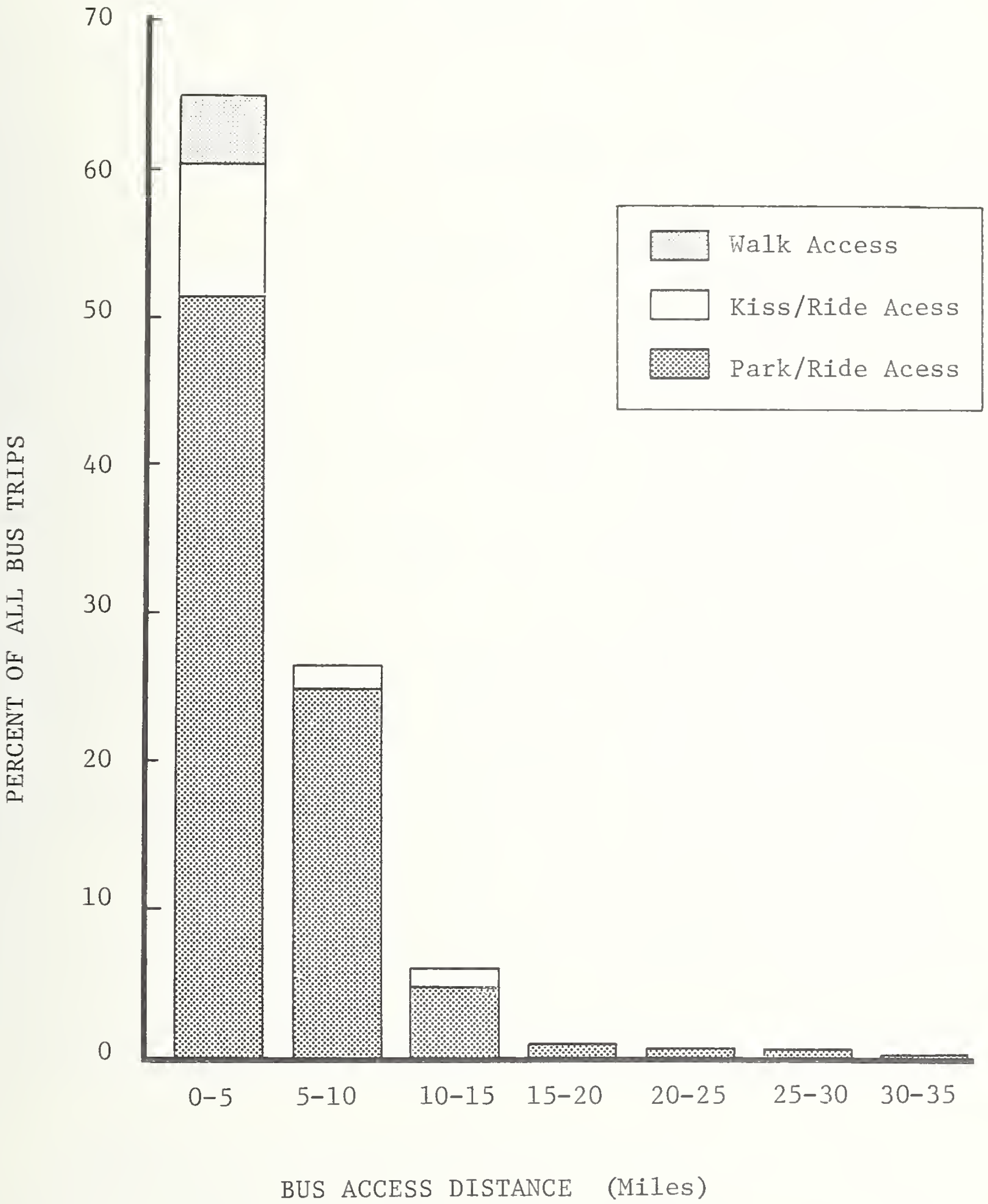

FIGURE 8-1. DISTRIBUTION OF BUS ACCESS DISTANCE BY ACCESS MODE

Selected characteristics tabulated by access mode are presented for bus riders in Table 8-5. These include the following:

1. auto availability (percent with autos divided by licensed drivers greater than or equal to one);

2. percent male; and

3. percent riding the bus five days a week.

As shown, auto availability was highest among those who drove alone to a park-and-ride lot (89.1 percent indicated at least one auto available for each licensed driver in the household). This is not surprising, though, since this mode of access requires the greatest commitment of an auto. The lowest auto availability (34.0 percent with autos divided by licensed drivers greater than or equal to one) was observed among those who were dropped off at the bus stop by another person making a special trip. This, too, is not surprising, since this form of kiss-and-ride access represents a significant inconvenience to the person making the special trip.

The access mode with the largest proportion of males (68.3 percent) was walk. The smallest proportion (22.9 percent) was observed among those dropped off by another person continuing on to another destination. One interpretation of this would be that in situations where an auto is shared for the work trip in households in which both husband and wife are employed, it is the husband who typically retains the auto. For the other form of kiss-and-ride access (i.e., dropped off by another person making a special trip), the proportion of males was much higher (66.2 percent). To the extent that this mode of access is used predominantly among single-worker households and that traditionally in such households the worker is male, this would be expected.

Frequency of bus use (i.e., the proportion riding the bus five days a week) showed little variation by access mode. Two points, though, are worth noting. First, the proportion riding the bus five days a week was highest among those driving with passengers to a park-and-ride facility. This would suggest that this commuting arrangement, which essentially represents a form

TABLE 8-5. BUS RIDERSHIP CHARACTERISTICS BY ACCESS MODE

	Percent of Those Using Access Mode		
Access Mode	Autos/Licensed Driver ≥ 1	Males	Ride Bus 5 Days/Week
Walk	45.2%	68.3%	84.1%
Park/Ride			
Drive Alone	89.1	38.9	80.8
Drive with Passenger(s)	70.0	45.1	89.8
Passenger	37.1	31.4	82.1
Kiss/Ride			
Dropped-off	46.4	22.9	73.0
Special Trip	34.0	66.2	85.9
All Bus Riders	76.6%	40.0%	81.4%

of ridesharing, is done on a more regular basis. Second, this proportion was lowest among those dropped off at a bus stop by someone continuing on to another destination.

8.2 TRAVELLER CHARACTERISTICS

8.2.1 Socioeconomic

Socioeconomic characteristics of peak direction travellers on the North Freeway during the morning peak period are presented in Table 8-6. As shown, the average annual household income among North Freeway travellers was quite high, ranging from about $37,000 for bus riders to $42,500 for vanpool drivers versus about $21,000 for the entire Houston region.

In terms of occupation among auto users, a higher proportion of auto passengers were in executive, professional or managerial positions (63.2 percent) relative to both single occupant auto drivers (50.7 percent) and multiple occupant auto drivers (56.0 percent), while the proportion involved in sales was somewhat lower (5.3 percent versus 7.9 percent for single occupant auto drivers and 10.7 percent for multiple occupant auto drivers). A higher proportion of single occupant auto drivers were employed as craftspersons or factory workers (15.8 percent) relative to multiple occupant auto drivers (8.0 percent) and, in particular, relative to auto passengers (5.2 percent), while a lower proportion were clerical or office workers (15.1 percent for single occupant auto drivers versus 20.0 percent for multiple occupant auto drivers and 21.1 percent for auto passengers).

While some of these differences could be attributable to the nature of these various occupations (e.g., irregular commuting schedules and the need for an auto during the day among those involved in sales), others might be attributable to locational differences among various employment categories. For example, since a much higher proportion of auto passengers were employed in the CBD, one would expect that the distribution of occupations for this

TABLE 8-6. SOCIOECONOMIC CHARACTERISTICS OF PEAK PERIOD, PEAK DIRECTION NORTH FREEWAY TRAVELLERS

	Auto Drivers				Vanpoolers	
	Single Occupant	Multiple Occupant	Auto Passengers	Bus Riders	Drivers	Passengers
Annual Household Income						
< $15,000	4.3%	4.3%	1.3%	9.2%	0.0%	6.4%
$15,000-$24,999	15.6	15.9	16.9	17.2	8.1	14.0
$25,000-$39,999	44.7	31.8	35.1	37.6	43.9	34.4
$40,000-$59,999	25.5	37.7	41.6	25.3	36.6	32.6
≥ $60,000	9.9	10.1	3.2	10.6	11.4	11.8
MEAN	$39,000	$41,000	$39,500	$37,000	$42,500	$39,500
Occupation						
Sales	7.9%	10.7%	5.3%	1.1%	1.0%	1.7%
Executive/ Professional/Manager	50.7	56.0	63.2	52.0	76.9	61.8
Craftsman/Factory	15.8	8.0	5.2	0.7	2.5	1.0
Clerical/Office	15.1	20.0	21.1	43.1	13.3	29.6
Service	3.9	1.3	0.0	0.2	0.5	0.1
Other	6.6	4.0	5.2	2.9	3.1	5.8
Age						
16-25 years	13.2%	6.6%	10.3%	28.0%	4.1%	13.5%
26-35	34.4	36.8	35.9	40.2	37.1	34.2
36-45	27.8	28.9	29.5	18.3	35.6	26.4
46-55	19.9	23.7	16.7	10.9	19.1	17.8
56-64	3.3	2.6	7.7	2.3	3.6	7.2
65+	0.7	1.3	--	0.3	--	--
MEAN	37.1 yrs	38.7 yrs	37.6 yrs	32.5 yrs	37.9 yrs	36.9 yrs
Gender						
Male	68.0%	80.3%	64.1%	42.2%	86.0%	62.5%
Female	32.0	19.7	35.9	57.8	14.0	37.5
SAMPLE SIZE	154	75	78	864	202	1,795

group would reflect the distribution of CBD employment (i.e., office-related versus industrial-related employment) to a greater extent that that for auto drivers.[1]

As shown in Table 8-6, the distribution of occupations among bus riders differed in many respects from that of auto users. Among bus riders, for example, there was a much higher proportion of clerical and office workers (43.1 versus 15.1 to 21.1 percent for auto users) and a much lower proportion of craftsperson and factory workers (0.7 versus 5.2 to 15.8 percent for auto users). Again, while these differences may reflect variations in travel behavior related to occupation, they are more likely the result of locational differences (e.g., since 95 percent of contraflow lane bus riders work in the CBD, it is not surprising that their employment characteristics reflect those of the CBD).

Another difference related to occupation is the much lower proportion of bus riders who were employed in sales positions (1.1 percent) relative to auto users (5.3 to 10.7 percent). In this case the relatively low proportion of bus riders is most likely attributable to the nature of the occupation (i.e., the need for a car during the day and, in some cases, the availability of a company car for those employed in sales positions).

The distribution of occupations among vanpool passengers was similar to that of bus riders, with the exceptions of a greater proportion in executive, professional or managerial positions (61.8 versus 52.0 percent) and a smaller proportion in clerical/office positions (29.6 versus 43.1 percent).

The occupational characteristics of vanpool drivers were similar to those of vanpool passengers, with the exceptions of a much higher proportion of executives/professionals/managers, and a much lower proportion of clerical/office workers. Since the majority of the vanpools operating on the contraflow lane at the time that the travel surveys were administered were employer-sponsored, this could reflect a tendency of employers to assign the responsibility of operating a vanpool to higher level employees.

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[1]In 1981, 79 percent of CBD employment was categorized as "office", with an additional 6 percent as "public" and 3 percent "institutional. Only 2 percent of CBD employment was categorized as "industrial".

As shown in Table 8-6, bus riders, with an average age of 32.5 years, were somewhat younger relative to other freeway users, whose average age ranged from 36.9 years for vanpool passengers to 38.7 years for drivers of multiple occupant autos. In particular, the proportion of bus riders 25 years of age or younger (28.0 percent) was much greater than that for any other user group. In addition, the proportion of bus riders who were female (57.8 percent) was much greater than any other freeway user group, which were all predominantly male. While to a certain extent these differences may indicate that all else being equal younger female employees are more likely to choose transit, it is also possible that they are closely related to the differences in occupation noted earlier, which in turn were related to the locational aspects of various employment categories. For example, 94.4 percent of all clerical/office workers using transit were female. Since this occupational category accounted for 44.2 percent of all bus riders, 41.8 percent of all peak period bus riders were female clerical/office workers.

Socioeconomic characteristics of peak versus off-peak North Freeway travellers are presented in Table 8-7. Characteristics of peak direction travellers presented here represent a weighted combination of results from the surveys of auto drivers, auto passengers, vanpool drivers, vanpool passengers and bus passengers which were administered in December 1980. Characteristics of off-peak direction travellers are represented by the results of the survey of off-peak direction auto users, also conducted in December 1980. As shown, the average household income of off-peak travellers was somewhat less than that for peak direction travellers ($35,500 versus $38,500). In terms of occupation, the distributions of employment type for these two groups were similar, with the exception of the lower proportion of off-peak direction travellers who were clerical or office workers (12.5 versus 21.4 percent). This probably reflects the location of office-related employment within the CBD, which was the destination of 50 percent of all peak direction freeway users. In terms of both average age and percent male, off-peak direction travellers appeared to be quite similar to peak direction travellers.

TABLE 8-7. SOCIOECONOMIC CHARACTERISTICS OF NORTH FREEWAY TRAVELLERS: PEAK VERSUS OFF-PEAK DIRECTION

	Peak Direction	Off-Peak Direction
Annual Household Income		
< $15,000	4.7%	10.2%
$15,000-$24,999	14.8	25.8
$25,000-$39,999	38.7	32.7
$40,000-$59,999	30.9	19.1
≥ $60,000	9.7	12.2
MEAN	$38,500	$35,000
Occupation		
Sales	6.9%	7.5%
Executive/Professional/Manager	54.7	52.5
Craftsman/Factory	9.6	12.5
Clerical/Office	21.4	12.5
Service	2.1	3.1
Other	5.1	11.9
Age		
<16 years	0.0%	1.2%
16-25	12.9	13.7
26-35	35.8	42.2
36-45	27.3	14.3
46-55	19.1	19.9
56-64	3.9	6.8
65+	0.6	1.9
MEAN	36.5 yrs	36.6 yrs
Gender		
Male	66.7%	63.5%
Female	33.3	36.5
SAMPLE SIZE	3,172	164

8.2.2 Time at Present Residence and Employment Location

The length of time that peak direction North Freeway travellers had been at their present residence and with their current employer at the time that the travel surveys were administered are presented in Table 8-8. As shown, among auto users, drivers of single occupant autos had been at their residence for a somewhat longer period of time relative to drivers of multiple occupant vehicles and auto passengers. In terms of employment location, drivers of multiple occupant autos had been with their current employer for a somewhat longer period of time (70.6 months) than drivers of single occupant vehicles (59.8 months) and auto passengers (57.1 months).

Bus riders had been at their present residence and with their current employer for the shortest period of time (39.1 and 41.4 months, respectively) relative to other North Freeway travellers. Nearly half of the bus riders surveyed indicated that they had moved to their current residence after contraflow operation began (i.e., within the previous 16 months). For all North Freeway travellers, though, only 22 percent reported moving in the previous 16 months, and well over half had been at the same residence for more than three years. It would appear, then, that to a great extent the increase in bus ridership that occurred over the course of the demonstration project can be attributed to people moving into the corridor and, most likely, new to the Houston area as well.

Although there is no data to support any conclusions regarding this apparently increased likelihood of new residents to choose transit, one possible explanation is related to the travel conditions existing at the time that decisions regarding residential location, auto ownership level, and work trip mode choice were made. In the case of longer term residents, for example, these decisions were made when bus service in the North Freeway corridor was much more limited, if it existed at all. Further, congestion on the freeway was relatively less severe, and gasoline prices had not escalated as a result of the energy crisis which occurred during the spring and summer of 1979. As conditions changed (i.e., congestion and fuel prices increased, transit service was expanded, and contraflow operation began) many of these

TABLE 8-8. LENGTH OF TIME IN NORTH FREEWAY CORRIDOR

	Auto Drivers				Vanpoolers	
	Single Occupant	Multiple Occupant	Auto Passengers	Bus Riders	Drivers	Passengers
Time at Present Residence						
0-16 months	18.2%	14.7%	20.5%	47.3%	7.7%	32.2%
17-36 months	24.0	22.7	21.8	21.6	28.9	24.1
37-60 months	16.2	30.7	19.2	12.8	30.4	19.7
> 60 months	41.6	32.0	38.5	18.3	33.0	24.0
MEAN	69.9 mos	60.7 mos	59.0 mos	39.1 mos	60.9 mos	44.6 mos
Time with Current Employer						
0-16 months	30.9%	23.3%	27.0%	53.0%	7.8%	30.8%
17-36 months	19.8	17.8	23.0	16.1	21.9	22.5
37-60 months	16.4	17.8	14.9	11.3	26.0	16.9
> 60 months	32.9	41.1	35.1	19.5	44.3	29.8
MEAN	59.8 mos	70.6 mos	57.1 mos	41.4 mos	82.8 mos	57.3 mos
SAMPLE SIZE	154	76	78	684	202	1,795

longer term residents may have desired to change from auto to transit, but to a certain extent found themselves "locked in" to auto as a result of their earlier residential location and auto ownership choices.

People moving into the North Freeway corridor during the course of the demonstration faced a very different set of conditions at the time of their choice of residential location. Further, those people with more than one auto moving to Houston from elsewhere in the country probably were also faced with the decision of either re-locating all of their household vehicles or selling one (or more) prior to moving. As a result, these people had much more flexibility in adapting their residential location and auto ownership decisions to choice of mode for their work trip.

Another possible explanation (again, without supporting data) for the higher level of transit use among people moving into the North Freeway corridor could be that many of these people, particularly those moving to Houston from other cities having a fairly extensive transit system, had used transit for their former commute. This would have two implications. First, for some of these people, to commute by auto upon arriving in Houston may have required the purchase of an additional auto (or, perhaps, the replacement of an older vehicle by a newer, more reliable one). Secondly, since these people had already accepted the concept of public transportation for commuting purposes elsewhere, they would probably have been more inclined to do so in Houston as well, particularly in view of the extensive improvements to bus service made in the North Freeway corridor.

Among vanpoolers, nearly one-third of the vanpool passengers surveyed had moved into the corridor after contraflow operation of the North Freeway had started. While this represents a somewhat larger proportion relative to auto users (32.2 verus 14.7 to 20.5 percent for auto users) it is much smaller than that noted earlier for bus riders (47.3 percent). In the case of bus riders, it was hypothesized that this relatively high proportion might be related to the travel conditions existing at the time decisions related to residential location, auto ownership, and work mode choice were made. The somewhat smaller proportion observed for vanpool passengers would suggest that while this hypothesis could also apply to vanpoolers, it would be a somewhat less important factor.

Unlike bus riders and vanpool passengers, very few vanpool drivers (7.7 percent) moved into the North Freeway corridor after the opening of the contraflow lane. Perhaps of more interest is the relationship between time at present residence and time with current employer. As shown in Table 8-8, the average time that vanpool drivers had been at their present residence was 60.9 months, while they had been with their current employer for 82.8 months. (Nearly half had been with the same employer for longer than five years.) In contrast, for most other North Freeway travellers, the average length of time at their present residence was greater than the average length of time with their present employer (e.g., 69.9 versus 59.8 months for single occupant auto drivers, and 59.0 versus 57.1 months for auto passengers). These results would suggest that vanpool drivers (and to a lesser extent, vanpool passengers) are typically those employees who have been with a single employer for a relatively long period of time.

The length of time that peak and off-peak direction travellers had been at their residence and employer at the time of the travel surveys (December 1980) are presented in Table 8-9. As shown, while off-peak direction travellers had, on average, been at their residence for a much longer period of time than peak direction travellers (104 versus 61 months), they had been with their current employer for a considerably shorter period of time (43 versus 60 months). Although not supported by available data, one possible explanation for this could be that off-peak direction travellers may have formerly been employed within the CBD, but had recently changed employment to one of the newer suburban firms and were now "reverse commuting."

8.2.3 Auto Availability

Several measures of auto availability are presented in Table 8-10. As shown, among auto users the average household auto ownership of auto drivers is somewhat higher than that for other North Freeway travellers (2.38 and 2.37 autos per household for single and multiple occupant auto drivers,

TABLE 8-9. LENGTH OF TIME IN NORTH FREEWAY CORRIDOR: PEAK VERSUS OFF-PEAK DIRECTION

	Peak Direction	Off-Peak Direction
Time at Present Residence		
0-16 months	22.0%	15.4%
17-36 months	23.3	25.3
37-60 months	19.6	13.6
>60 months	35.0	45.7
MEAN	61.0 mos	103.8 mos
Time with Current Employer		
0-16 months	31.0%	40.8%
12-36 months	19.8	28.0
37-60 months	15.8	14.0
>60 months	33.2	17.2
MEAN	59.7 mos	43.1 mos
SAMPLE SIZE	3,172	164

TABLE 8-10. AUTO AVAILABILITY: PEAK PERIOD, PEAK DIRECTION NORTH FREEWAY TRAVELLERS

	Auto Drivers				Vanpoolers	
	Single Occupant	Multiple Occupant	Auto Passengers	Bus Riders	Drivers	Passengers
Auto Ownership						
0	0.0%	0.0%	0.0%	0.2%	1.1%	0.3%
1	14.6	11.3	16.7	29.1	19.5	22.5
2	52.8	59.2	60.3	50.7	45.3	57.5
3	18.1	18.3	19.2	14.4	24.7	14.1
4+	14.4	11.2	3.9	5.6	9.5	5.6
MEAN (Autos/HH)	2.38	2.37	2.13	1.99	2.27	2.04
Perceived Availability of Auto For Trip						
Always Available	94.4%	91.5%	85.9%	78.6%	67.2%	76.9%
Rarely Available	0.7	2.8	6.4	11.3	9.4	6.6
Inconvenient for Other Family Members	4.9	5.6	7.7	10.1	23.4	16.2
Auto Availability Percent of Households						
# Autos/# Licensed Driver $\geq$ 1	86.1%	85.7%	79.5%	74.7%	70.5%	75.3%
SAMPLE SIZE	154	76	78	864	202	1,795

respectively, versus 1.99 to 2.27 autos per household for other North Freeway travellers). In terms of perceived auto availability, 94.4 percent of single occupant auto drivers and 91 percent of multiple occupant auto drivers indicated that an auto was always available. This is a somewhat higher proportion than that for auto passengers (85.9 percent) and that for bus riders (78.6 percent), vanpool drivers (67.2 percent) and vanpool passengers (76.9 percent). A more objective measure of auto availabilty, defined as household auto ownership level divided by the number of licensed drivers in the household, is also presented in Table 8-10. As shown, the proportion of travellers for whom the number of household autos equaled or exceeded the number of licensed drivers was highest among auto drivers (86.1 percent for drivers of single occupant autos and 85.7 percent for drivers of multiple occupant vehicles) and somewhat lower for auto passengers (79.5 percent).

Auto ownership is lowest among bus riders (1.99 autos per household). It is worth noting, though, that only a very small fraction of bus riders (0.2 percent) reported owning no autos. In terms of perceived auto availability, 78.6 percent of surveyed bus riders indicated that an auto was always available for their trip, while 10.1 percent indicated that an auto was never available. Relative to other North Freeway travellers, perceived auto availability among bus riders was lower than that for auto users and somewhat higher than vanpoolers. These results are reflected in the proportion of bus riders for whom the number of household autos was equal to or exceeded the number of licensed drivers.

Two points are worth noting with respect to the auto availability of bus riders. First, while auto availability among bus riders is somewhat lower relative to auto users, nearly 80 percent indicated that an auto was always available, with about 10 percent reporting that an auto was never available. For the most part, then, it would appear that the use of transit on the part of North Freeway travellers was a matter of choice rather than dependency. Second, the causality between auto availability and transit use is not altogether clear. While some people may have chosen transit because of a relatively low level of auto availability, others may have reduced their auto ownership level as a result of having chosen transit once it became more widely available in the North Freeway corridor. As shown in Table 8-11, for example, 7.6 percent of those bus riders surveyed in December 1980 indicated that they had avoided purchasing another vehicle as a result of riding the bus, while an additional 1.7 percent indicated that they had sold a vehicle and did not replace it.

Among vanpoolers (see Table 8-10), the auto ownership level of vanpool drivers was somewhat greater than that for vanpool passengers (2.27 versus 2.04 autos per household). However, a greater proportion of vanpool passengers (76.9 versus 67.2 percent for vanpool drivers) indicated that an auto was always available for their commute. These findings in terms of perceived auto availability are also reflected in a more objective measure defined as household auto ownership divided by the number of household members having a drivers license. As shown, the proportion of vanpool drivers with at least one auto for each licensed driver in the household was 70.5 percent, which was lower than that for all other North Freeway travellers.

This lower auto availability among vanpool drivers can be interpreted in two ways. First, those electing to serve as vanpool drivers may have been motivated by the need for an additional household vehicle. On the other hand, by having a vehicle (i.e., the van) available for commuting and possibly other non-work related travel, the van could have essentially replaced other household vehicles, leading to a reduction in household auto ownership. While the need for an additional vehicle probably influenced the decision of many vanpool drivers to operate a vanpool, the results presented in Table 8-11 related to the impact of vanpooling on household auto ownership suggest that to a certain extent the lower auto availability among vanpool drivers was the result rather than the cause of their decision to operate a vanpool. For example, as shown in Table 8-11, while 41.2 percent of vanpool drivers indicated that vanpooling had no effect on household auto ownership, 18.6 percent delayed the replacement of an existing vehicle, 15.5 percent avoided buying another vehicle, 14.4 sold a vehicle without replacing it, and an additional 10.5 percent indicated that they would probably sell a vehicle.

TABLE 8-11. IMPACT OF BUS USE AND VANPOOLING ON HOUSEHOLD AUTO OWNERSHIP

Impact	Percent of: Bus Riders	Vanpool Drivers	Vanpool Passengers
No Effect	75.1%	41.2%	65.3%
Delayed Vehicle Replacement	13.5	18.6	18.5
Avoided Vehicle Purchase	7.6	15.5	9.1
Reduced Auto Ownership Level	1.7	14.4	4.1
Will Probably Reduce Auto Ownership Level	2.2	10.3	3.0
SAMPLE SIZE	864	202	1,795

While changes in auto ownership resulting from vanpooling were also reported by vanpool passengers, the impact was much less pronounced. For example, nearly two-thirds of vanpool passengers indicated that vanpooling had no impact on household auto ownership. The greater impact on vanpool drivers probably reflects the availability of the van for use by many vanpool drivers for non-work related travel.

8.2.4 Perceptions of Contraflow Lane

Perceptions of bus riders regarding the contraflow lane and its effect on their trip to work are presented in Table 8-12. As shown, 57 percent of the bus riders responding to the survey indicated that the contraflow lane was the most important factor in their decision to ride the bus (i.e., they would not have ridden the bus otherwise), while 33 percent indicated that it was one of several factors, and the remaining 10 percent indicated that they would have ridden the bus anyway. These results in general correspond to those based on the more optimistic assumption in the analysis of changes in ridership for the two bus routes in service prior to contraflow operation presented earlier (i.e., that 56.9 percent of current ridership could be directly attributable to the contraflow lane).

In terms of perceived travel time savings on the North Freeway relative to non-priority lanes, bus riders reported that the contraflow lane saved an average of 21 minutes in the morning and 27 minutes in the afternoon. In terms of door-to-door travel time, travel by bus on the contraflow was on average 6.5 minutes shorter relative to driving. This would indicate that the time savings resulting from the contraflow lane more than offsets any wait time, access time and/or access circuity associated with bus travel.

Relatively few bus riders (16 percent) felt that the contraflow lane was underutilized. Not surprisingly, when asked what would be the single most important means of increasing contraflow lane utilization, 48 percent indicated more bus service, while 26 percent indicated more park-and-ride lots.

Perceptions of vanpool drivers and vanpool passengers regarding the contraflow lane and its impact on their trip to work are presented in Table

TABLE 8-12. BUS RIDERS' PERCEPTIONS OF CONTRAFLOW LANE

IMPORTANCE OF CONTRAFLOW LANE IN DECIDING TO RIDE THE BUS	
Most Important (would not have ridden the bus otherwise)	57%
Important (one of several factors)	33
Not Important (would have ridden the bus anyway)	10
PERCEIVED TRAVEL TIME SAVINGS ON NORTH FREEWAY	
AM	21 minutes
PM	27 minutes
PERCEIVED DOOR-TO-DOOR TRAVEL TIME SAVINGS RELATIVE TO DRIVING (ONE-WAY AVERAGE)	6.5 minutes
PERCEIVED COST SAVINGS RELATIVE TO DRIVING	$54.65/month
CONTRAFLOW LANE UNDERUTILIZED?	16%
MOST IMPORTANT MEANS OF INCREASING CONTRAFLOW LANE UTILIZATION:	
More Marketing of Existing Bus Service	12%
More Bus Service	48
More Park-and-Ride Lots	26
Allow Carpools	10
Encourage More Vanpooling	4

8-13. As shown, only 27.1 percent of vanpool passengers and 21.3 percent of vanpool drivers indicated that the contraflow lane was the single most important factor in their decision to vanpool (i.e., they would not have vanpooled otherwise). These are much smaller proportions relative to that observed among bus riders (56.0 percent) and are consistent with the slower growth in vanpool use of the contraflow lane. Among vanpool drivers, 43.1 percent indicated that they would have vanpooled whether or not the contraflow lane had been opened (versus 27.1 percent for vanpool passengers and 10.0 percent for bus riders). This would suggest that other factors, such as free commuting and use of the van for other purposes, were more important considerations.

In terms of perceived travel time savings on the North Freeway relative to non-priority lanes, vanpool passengers reported that the contraflow lane saved an average of 18.8 minutes in the morning and 24.0 minutes in the afternoon, while vanpool drivers reported travel time savings of 16.6 and 22.7 minutes in the morning and afternoon respectively. In terms of door-to-door travel time, while vanpool passengers reported an average savings of 10.1 minutes relative to driving, vanpool drivers indicated that their trip took 2.1 minutes longer than if they were to drive alone. This difference probably reflects the time spent by vanpool drivers in picking up and dropping off passengers.

A relatively small proportion of vanpool passengers (15.3 percent) and an even smaller proportion of vanpool drivers (9.2 percent) felt that the contraflow lane was under utilized. This difference could reflect an increased awareness among vanpool drivers of other vehicles using the lane. With respect to increasing contraflow lane utilization, a majority of both vanpool drivers (64.5 percent) and vanpool passengers (54.0 percent) felt that the most important means would be to encourage more vanpools. An interesting difference among vanpool drivers and passengers is in their response to the idea of allowing carpools use of the contraflow lane. While 15.9 percent of vanpool passengers thought that this would be the most important means of increasing contraflow lane utilization, this view was shared by only 6.1

TABLE 8-13. VANPOOLER'S PERCEPTIONS OF CONTRAFLOW LANE

	Vanpool Drivers	Vanpool Passengers
IMPORTANCE OF CONTRAFLOW LANE IN DECIDING TO VANPOOL		
Most Important (would not have vanpooled without it)	21.3%	27.1%
Important (one of several factors)	35.5	45.8
Not Important (would have vanpooled anyway)	43.1	27.1
PERCEIVED TRAVEL TIME SAVINGS ON NORTH FREEWAY		
AM	16.6 min.	18.8 min.
PM	22.7 min.	24.0 min.
PERCEIVED DOOR-TO-DOOR TRAVEL TIME SAVINGS RELATIVE TO DRIVING (One-Way Average)	+2.1 min.	-10.1 min.
CONTRAFLOW LANE UNDERUTILIZED? (Percent Responding Yes)	9.2%	15.3%
MOST IMPORTANT MEANS OF INCREASING CONTRAFLOW LANE UTILIZATION		
More marketing of existing bus service	7.6%	6.2%
More bus service	5.1	9.7
More Park-and-Ride lots	13.2	11.1
Allow carpools	6.1	15.9
Encourage more vanpools	64.5	54.0
Ease vanpool authorization requirements	3.6	3.2

percent of vanpool drivers. This probably reflects a desire on the part of vanpool drivers to keep the contraflow lane as free as possible from congestion.

8.3 KEY FINDINGS

8.3.1 Trips Served by Contraflow Lane

Because of its limited access and egress, the contraflow lane serves primarily CBD-destined trips originating beyond the contraflow lane entrance, ten miles north of downtown Houston. While only about half of all North Freeway travellers entering the freeway north of the contraflow lane entrance were destined to the CBD, over 95 percent of bus riders and nearly 75 percent of all vanpoolers were travelling to downtown Houston.

8.3.2 Former Modes of Bus Riders and Vanpoolers

The distribution of former modes among those bus riders surveyed in December 1980 who were travelling the North Freeway prior to contraflow operation was quite similar to the mode split for all morning peak period North Freeway travellers prior to contraflow operation. Among vanpoolers, though, a disproportionate number were former carpoolers and, to a lesser extent, bus riders. This would suggest that vanpooling is competing to a certain extent with both carpooling and bus as an alternative to driving alone.

8.3.3 Importance of Park-and-Ride Facilities

Nearly 85 percent of all bus riders utilized park-and-ride lots in order to access North Freeway corridor buses, while only 3.4 percent walked. (The remaining 13.6 percent used kiss-and-ride access.) While this is not surprising in view of the relatively low density of the areas served by the contraflow lane and the express-nature of the bus routes serving this area, it does emphasize the importance of the park-and-ride facilitis as a factor contributing to the increase in bus ridership.

8.3.4 Socioeconomic Characteristics

In terms of socioeconomic charcteristics, the average annual household income of all morning peak period, peak direction North Freeway travellers was significantly higher than that for the Houston region as a whole ($38,500 versus $21,000). Among North Freeway travellers, bus riders had the lowest average income ($37,000) and vanpool drivers the highest ($42,500). With the exception of bus riders, all other groups of North Freeway travellers were predominantly male, with the highest proportion (86.0 percent) found among vanpool drivers. Among bus riders, 57.8 percent were female. In terms of occupation, the majority of travellers were classified as executive, professional, or managerial. This category was largest among vanpool drivers (76.9 percent) and smallest among drivers of single occupant autos.

8.3.5 Influence of Population Growth

Nearly half of the bus riders surveyed in December 1980 had moved into the North Freeway corridor area after the contraflow lane had been implemented (versus 22 percent among all North Freeway travellers). This would suggest that a large portion of increased bus ridership was the result of people new to the area deciding to ride the bus rather than longer term residents switching from auto.

9. TRAVEL AND TRAVEL-RELATED IMPACTS

Associated with the increased use of bus and vanpool by North Freeway travellers were changes in peak period mode shares which in turn led to a number of other travel-related impacts. This chapter first examines the changes in mode shares and auto occupancies that occurred subsequent to the implementation of contraflow operation and other corridor transportation improvements. Then, the implications of these changes on vehicle-miles of travel (VMT), fuel consumption, and vehicle emissions are presented.

9.1 MODE SHARES AND AUTO OCCUPANCIES

9.1.1 Mode Shares

Peak-direction peak period mode shares for the North Freeway are presented in Table 9-1 for the summer months of 1978 and 1979 (prior to contraflow operation) and the fall of 1980. As shown, there was relatively little change between the summer of 1978 and 1979 (i.e., during the year preceeding contraflow operation). A slightly higher percent of morning commuters travelled in three-or-more person carpools in the summer of 1979 compared to 1978. However, this increase can be accounted for almost entirely by the decrease in two-person carpools. Afternoon drive alone mode shares remained virtually unchanged between 1978 and 1979 while the shares of both carpool modes increased slightly. The percent of people vanpooling in both the morning and afternoon increased by about two-thirds between 1978 and 1979. While this is the largest percentage change observed for any of the modes, it was on a relatively small base of 425 vanpoolers in 1978, and therefore represents a relatively small number of trips in absolute terms. Bus use appears to have decreased between 1978 and 1979.

The impact of the contraflow lane and other corridor improvements on peak period, peak direction mode shares appears to have been fairly dramatic. After the contraflow lane had been in operation for slightly less than one year, the fraction of people travelling by auto in the morning peak period (compared to one year earlier) had dropped by approximately 15 percent (from

TABLE 9-1. NORTH FREEWAY MODE SHARES

	Inbound 7-9 AM			Outbound 4-6 PM		
	1978	1979	1980	1978	1979	1980
Drive Alone	.560	.565	.547	.479	.479	.389
2-Person Carpool	.276	.246	.184	.293	.309	.216
3+ Person Carpool	.095	.123	.066	.131	.134	.151
Vanpool	.026	.043	.083	.030	.051	.102
Commuter Bus[1]	.031	.016	.113	.054	.019	.133
Airport and Intercity Bus	.012	.007	.007	.013	.008	.009
	1.000	1.000	1.000	1.000	1.000	1.000

TABLE 9-2. NORTH FREEWAY AUTO MODE SHARES BY OCCUPANCY

	Inbound 7-9 AM			Outbound 4-6 PM		
	1978	1979	1980	1978	1979	1980
Drive Alone	.602	.605	.686	.530	.520	.515
2-Person Carpool	.296	.263	.231	.324	.335	.286
3+ Person Carpool	.102	.132	.083	.145	.145	.200

1 Commuter bus shares are somewhat overstated for 1978 since they include HouTran buses which operated on the North Freeway between I-610 and downtown only. Non-contraflow commuter bus patronage is not included for 1980.

Sources: Transportation Newsletter, Vol. 1, No. 1, November 1978; Transportation Newsletter, Vol. 2, No. 1, October 1979; and Bieswenger, Hoch, and Associates and Texas Transportation Institute, "North Freeway Data Collection: Technical Memo," prepared for Metro, January 1981.

.934 to .797) while the fraction of people travelling by either bus or van had increased by about 208 percent (from .066 to .203). The decrease in auto, though, occurred primarily among the two carpool modes during the morning peak period. For example, while the drive alone share decreased by 3.2 percent between 1979 and 1980 (from .565 to .547), the proportion of all auto trips represented by drive alone (see Table 9-2) increased by 13.4 percent (from .605 to .686).

One possible explanation for this decrease in carpooling relative to drive alone would be that the shifts to bus and vanpool observed during the morning peak period were accounted for, to a large extent, by former carpoolers. However, as discussed earlier in Section 8.1.3, the distribution of former modes for new bus riders reported in the December 1980 travel surveys was for the most part proportional to the mode shares of all North Freeway travellers prior to contraflow operation. Further, while the proportion of vanpoolers reporting carpool as their former mode was relatively high (.644 and .491 for vanpool drivers and passengers respectively versus the carpool share of .369 in 1979 for all North Freeway travellers), this would account for very little of the decrease in carpooling observed between 1979 and 1980.

9.1.2 Auto Occupancies

The average peak direction North Freeway auto occupancies are presented in Table 9-3. Because the distribution of passengers by auto occupancy had remained relatively stable during the year before the contraflow lane was opened, there was no significant change in the overall average auto occupancy (i.e., average auto occupancy increased slightly from 1.28 to 1.29 in the morning and from 1.36 to 1.38 in the afternoon).[1] One year after the contraflow lane was opened, though, the AM peak period auto occupancy had fallen to 1.21 and the afternoon occupancy had risen to 1.43, reflecting the changes in the mode shares noted in the previous section.

[1]The higher afternoon occupancy can be attributed to a higher proportion of non-work trips which typically have higher occupancies.

TABLE 9-3. NORTH FREEWAY PEAK DIRECTION AUTO OCCUPANCIES

	AM PEAK PERIOD	PM PEAK PERIOD
June 1978[a]	1.28	1.36
July 1979[a]	1.29	1.38
October 1980[a]	1.21	1.43

[a]Observations made at Link Road just south of I-610.

Sources: Houston-Galveston Area Council, "1978 Auto-Occupancy Count," Transportation Newsletter, Vol. 1, No. 1, November 1978; Transportation Newsletter, Vol. 2, No. 1, October 1979; and Bieswenger, Hoch, and Associates and Texas Transportation Institute, "North Freeway Data Collection: Technical Memo," prepared for Metro, January 1981.

9.2 VEHICLE MILES OF TRAVEL

9.1.2 Methodology

Perhaps the most straightforward approach to evaluating the effect of the contraflow lane on VMT and related impacts would be to compare measurements taken before and after contraflow operation, with the difference being attributable to the contraflow lane. In the Houston demonstration, though, there were a number of factors which precluded such an approach. In particular, Houston is an area which has experienced rapid growth in recent years. For example, based on the travel surveys administered in December 1980 (after 16 months of contraflow operation), 20 percent of those people travelling the North Freeway during the morning peak period at that time had moved into the corridor after the contraflow lane had been opened. Another factor complicating this analysis was the fact that the contraflow lane had been implemented as one of several transportation improvements in the North Freeway corridor. As a result, it was necessary to isolate as much as possible the effects of contraflow operation from those of expanded transit service, park-and-ride lots, etc.

The analysis approach employed essentially involved a comparison of VMT existing at the time of the travel surveys with an estimate of what it would have been had the contraflow lane not been implemented. An estimate of the former was developed from survey data (e.g., mode, trip length, occupancy, access mode and distance, etc.) and vehicle counts. The additional VMT which would have occurred had the contraflow lane not been implemented was estimated in two stages. First, bus riders and vanpoolers surveyed in December 1980 were categorized into one or more of three groups based on their response to the question regarding the degree of influence that the contraflow lane had on their decision to use transit or vanpool. This was done in an attempt to bound the VMT reduction which could be attributable to the contraflow lane. The three possible responses were:

1. Most important (would not have vanpooled/rode the bus without it);

2. Important (the contraflow lane was one of several factors); or

3. Not important (would have vanpooled/rode the bus anyway).

Within each of these categories, the difference between the VMT associated with the current bus or vanpool trip and that for the former mode used prior to contraflow operation was calculated on an individual basis using data provided from the surveys. For those individuals who moved into the North Freeway corridor after the contraflow lane began operation (i.e., those individuals with no former mode), a "prior" VMT was calculated based on trip length and the distribution of former modes of those individuals travelling in the corridor prior to contraflow operation.

9.2.2 Change Attributable to Contraflow Lane

The estimated changes in VMT attributable to North Freeway contraflow lane travellers are presented in Table 9-4 on an annual basis.[1] As shown, VMT figures are presented for each of three groups:

1. Influence group 1, which includes only those people indicating that they would not have vanpooled or taken the bus without the contraflow lane;

2. Influence groups 2, which includes influence group 1 plus those people who indicated that the contraflow lane was one of several factors in their decision to vanpool or take the bus; and

3. Influence group 3, which includes all vanpoolers and bus passengers using the contraflow lane.

The reduction in annual VMT attributable to just those people indicating that they would not vanpool or ride the bus without the contraflow lane was over 10 million vehicle-miles. If those people indicating that the contraflow lane was one of several factors influenceing their decision to vanpool or ride transit are also considered, the reduction in annual VMT would be over 20 million vehicle-miles. If the VMT reduction attributable to those people who would have vanpooled or ridden the bus anyway are included, the total VMT

[1]All VMT figures are derived from the survey of morning peak period travellers, which reflects the change in VMT for the AM peak period trip only. For annual estimates, these changes were multiplied by 500.

TABLE 9-4. ANNUAL CHANGES IN VMT ATTRIBUTABLE TO NORTH FREEWAY CONTRAFLOW LANE TRAVELLERS

		Number of People	Change in VMT (000's)	% Change in VMT for Group Indicated
Group 1:	People who would not vanpool/ride bus without contraflow lane			
	Bus Passengers[1]	1559	-7,134.1	-64.0
	Vanpoolers	556	-3,307.7	-61.7
Total		2,115	-10,441.8	-63.2
Group 2:	Group 1 plus people indicating contraflow lane was a factor in decision to vanpool/ ride bus			
	Bus Passengers[1]	2,417	-12,533.9	-67.6
	Vanpoolers	1,493	-7,852.4	-58.0
Total		3,910	-20,386.3	-63.6
Group 3:	All contraflow lane travellers			
	Bus Passengers[1]	2,662	-12,861.0	-66.6
	Vanpoolers	2,098	-11,178.6	-58.8
Total		4,760	-24,039.6	-62.7

[1] Bus VMT not included.

reduction would be about 24 million vehicle-miles. The VMT reduction attributable to just the contraflow lane, then, would be somewhere between 10 and 20 million vehicle-miles per year.

Before putting these changes in VMT resulting from changes in mode choice into percentage terms relative to total annual peak period VMT for the North Freeway, they must be adjusted to account for VMT associated with contraflow lane set-up, take-down, and enforcement vehicles (135,000 vehicle-miles annually) and bus operations (1,540,000 bus-miles annually, including deadheading). Adjusted VMT changes are presented in Table 9-5, both in absolute terms and in percentage terms relative to the total annual peak period VMT for the North Freeway of 301,350,000 vehicle-miles. As shown, the reduction in peak period VMT attributable to the contraflow lane ranged from 2.9 to 6.2 percent, while the total reduction in VMT (i.e., that attributable to increased bus service, park-and-ride lots, etc., as well as the contaflow lane) was 7.4 percent.

9.3 TRAVEL-RELATED IMPACTS

9.3.1 Fuel Consumption

The changes in fuel consumption associated with the lower level of VMT on the North Freeway relative to that which would occur in the absence of the contraflow lane are presented in Table 9-6. As shown, the reduction in fuel consumption attributable to the contraflow lane alone ranges from 1.8 to 4.8 percent, while the reduction attributable to all corridor transportation improvements is 5.8 percent.

In each instance the percentage reduction in fuel consumption is somewhat smaller than that for the corresponding reduction in VMT. A number of factors can be identified which contribute to this. For example, while those who park-and-ride saved a certain amount of VMT, the auto trip still involved a cold start. Since fuel efficiency is lowest during periods of cold engine operation, a somewhat lower proportional change in fuel consumption relative to VMT would be expected. Further, in the VMT analysis, auto, van, and bus

TABLE 9-5. ANNUAL CHANGES IN VMT INCLUDING MODE SHIFTS, CONTRAFLOW LANE OPERATIONS, AND BUS-MILES OF TRAVEL

	Group	Adjusted Change in Annual VMT (X 10^3)	% Change in Corridor VMT*
1.	People who would not vanpool/ride bus without contraflow lane	-8,767	-2.9%
2.	Group 1 plus people indicating contraflow lane was a factor in decision to vanpool/ride bus	-18,711	-6.2%
3.	All contraflow travellers	-22,365	-7.4%

* Using a base VMT of 301,300,000 vehicle miles.

TABLE 9-6. ANNUAL CHANGES IN FUEL CONSUMPTION

	Group	Change in Annual Fuel Consuption (10^3 Gallons)	% Change in Fuel Consumption
1.	People who would not vanpool/ride bus without contraflow lane	-352.5	-1.8%
2.	Group 1 plus people indicating contraflow lane was a factor in decision to vanpool/ride bus	-926.0	-4.8%
3.	All contraflow travellers	-1,121.0	-5.8%

Assumptions: Auto fuel economy for freeway trips (25 mph) = 16.5 mpg
Auto fuel economy for local trips (40 mph) = 19.0 mpg
Overall van fuel economy = 9.8 mpg

vehicle-miles are considered equally. With fuel consumption, though, the decrease in auto VMT combined with increased van and bus VMT results in a higher average per mile fuel consumption.

9.3.2 Emissions

Annual changes in emissions related to the changes in VMT associated with contraflow operation are presented in Table 9-7. As shown, the reduction in hydrocarbon (HC) emissions attributable to the contraflow lane ranges from 0.8 to 3.2 percent, while that for carbon monoxide (CO) ranges from 3.2 to 6.2 percent, and that for nitrogen oxides ranges from 1.0 to 3.7 percent.

TABLE 9-7. ANNUAL CHANGES IN EMISSIONS

		Total Change (Tons/Yr)	% Change in Corridor Emissions
Group 1: People who would not vanpool/ride bus without contraflow lane			
	HC	-7.7	-0.8%
	CO	-399.9	-3.2
	NO_x	-8.8	-1.0
Group 2: Group 1 plus people indicating contraflow lane was a factor in decision to vanpool/ride bus			
	HC	-32.2	-3.2
	CO	-764.8	-6.2
	NO_x	-32.2	-3.7
Group 3: All contraflow lane travellers			
	HC	-41.9	-4.2%
	CO	-908.1	-7.3
	NO_x	-40.5	-4.7

Assumptions:

HC: 11.58 grams/trip start-up, 8.3 grams/trip for hot soak, 2.24 grams/mile for travel at 25 mph, and 1.44 grams/miles for travel at 40 mph; 1980 fleet year, 70°F, 100% cold start trips.

CO: 176.6 grams/trip start-up, 30.7 grams/mile for travel at 25 mph, 2.24 grams/mile at 40 mph; 1980 fleet year, 70°F, 100% cold start trips.

NO_x: 39.4 grams/trip start-up, 2.46 grams/mile for travel at 25 mph, and 2.86 grams/miles for travel at 40 mph; 1980 fleet year, 70°F, 100% cold start trips.

10. CONCLUSIONS

This report has presented detailed results related to the operation and impacts of the North Freeway contraflow lane. The purpose of this final section is to synthesize this information into a number of conclusions related to the feasiblity and effectiveness of contraflow operation and to identify some of the costs and benefits associated with Houston's contraflow lane project.

10.1 FEASIBILITY

The success of the Houston North Freeway contraflow lane project has demonstrated the feasibility of contraflow operation of a relatively long freeway segment during both morning and afternoon peak periods. Specific factors related to feasibility highlighted by this demonstration include the following:

1. physical design of the freeway;
2. excess off-peak direction capacity;
3. safety;
4. enforcement; and
5. public acceptability.

10.1.1 Freeway Design

A prerequisite for contraflow operation is an appropriate freeway configuration. On the North Freeway locating the northern terminus of the contraflow lane at the intersection with North Shepherd was determined by the presence of entrance/exit ramps on the left side of the freeway at that location. When it was decided to extend priority treatment farther north in March 1981, it was necessary to use concurrent flow operation of the median shoulder. The feasibility of contraflow operation for other freeways, then, would depend to a large extent on the configuration of the specific freeway segment under consideration.

10.1.2 Off-Peak Direction Capacity

A second crucial factor related to the feasibility of contraflow operation is the availability of excess capacity in the off-peak direction. In those situations where sufficient excess capacity is not available, contraflow operation would adversely affect off-peak direction travel conditions.

In Houston, when contraflow operation of the North Freeway was first proposed in 1975, traffic conditions were ideal for such a project--the North Freeway had a high directional split (i.e., .75 in the morning peak period) and relatively low traffic volumes in the off-peak direction. By the time that the project was implemented, though, off-peak traffic had increased to the point that contraflow operation caused congestion at certain points on the freeway. To a large extent these adverse impacts on off-peak direction freeway travel were minimized by the use of various ramp control measures. Nonetheless, in view of Houston's continued growth, it was fully expected that traffic volumes would eventually reach a level which would make contraflow operation of the North Freeway infeasible.[1] In urban areas experiencing growth rates lower than Houston's, one would expect that contraflow operation would continue to be feasible (at least from the standpoint of traffic-related considerations) over a longer period of time.

10.1.3 Safety

Under normal freeway operation, vehicles travelling in opposing directions are separated by a median barrier. With contraflow operation, though, opposing traffic is carried on adjacent lanes. One of the prime safety-related concerns associated with contraflow operation, then, is providing an adequate means of lane separation.

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[1]Current plans are to replace the contraflow lane with a rever- sible median lane.

One function of lane separation with contraflow operation is to provide a constant reminder to off-peak direction drivers that the lane is being used by opposing traffic. This was of particular concern in this demonstration since at certain times of operation there were relatively few vehicles utilizing the contraflow lane. The means of maintaining lane separation implemented by the Metropolitan Transit Authority of Harris County (METRO) included lane separation pylons inserted every 40 feet, overhead signals indicating lane utilization, signs with flashing lights, etc. Since there were no instances of off-peak drivers intentionally entering the contraflow lane during the period of contraflow operation, it would appear that these measures were adequate.

A second function of lane separation would be to prevent unintentional entry into the contraflow lane by a vehicle travelling in the off-peak direction. In this case, maintaining the same degree of lane separation in contraflow operation as that provided by a median barrier in normal freeway operation is probably not feasible. During the 18-month demonstration period, there were three accidents in which off-peak direction autos entered the contraflow lane unintentionally and collided with a contraflow vehicle. One of these resulted in a fatality and several serious injuries. Since the off-peak direction vehicles involved in each of these accidents were essentially out of control when they entered the contraflow lane, some damage and/or injury would probably have occurred without contraflow operation. However, the outcome of these accidents may have been less severe.

A more indirect safety impact is related to changes in traffic conditions in the non-priority travel lanes associated with contraflow operation. In general, peak direction travel speeds increased as a result of contraflow operation, while off-peak direction speeds decreased. Correspondingly, the number of accidents decreased for peak direction travel and increased for off-peak direction travel. Overall, the accident rate during the first six months of contraflow operation was 12.5 percent less than that for the 6-month period preceeding the opening of the contraflow lane (2.1 versus 2.4 accidents per million vehicle-miles).

10.1.4 Enforcement

Unlike those concurrent flow priority treatment projects which allow carpools, enforcement of lane use restrictions for the contraflow lane was quite straightforward. This can be attributed to two factors. First, there was only one access point for entry to the contraflow lane (versus almost continuous access for non-separated concurrent flow priority treatment projects). Secondly, since only buses and vanpools were allowed access to the contraflow lane, autos attempting to enter the lane were very visible as violators. Overall, the incidence of violations was quite low (i.e., averaging about 14 violations or attempted violations per month), and enforcement was never really a major issue.

10.1.5 Public Acceptance

To a large extent, public acceptance of a priority treatment project such as the North Freeway contraflow lane depends on the extent and magnitude of adverse impacts on non-priority freeway users. The strong negative reactions from the public and media to concurrent flow priority projects in Boston and Los Angeles, for example, arose primarily in response to the severe impacts on congestion resulting from the restriction of an existing peak-direction travel lane for HOV use. In each of these projects a relatively large group of people (i.e., peak-direction travellers) were subjected to significantly increased congestion levels. With the North Freeway contraflow lane, though, both the number of people affected (i.e., off-peak direction travellers) and the magnitude of any adverse impacts were much smaller. As a result, there was very little opposition to the contraflow lane. However, if off-peak direction traffic volumes continue to increase it is conceivable that at some point travel conditions could deteriorate to a level which would trigger more vocal and widespread opposition.

10.2 EFFECTIVENESS

Due to the relatively long length of the contraflow lane (9.6 miles), its operation during both morning and afternoon peak periods, and the relatively high level of peak period congestion existing on the North Freeway, buses and vanpools authorized to use the contraflow lane experienced about a 40-minute reduction in peak hour travel times (15 minutes in the morning and 25 minutes in the afternoon) relative to vehicles in non-priority lanes. Because of this time savings, utilization of the contraflow lane was quite high as a result of fairly dramatic increases in bus and vanpool ridership which occurred during the first 33 months of operation. This section discusses overall utilization of the contraflow lane, the increases in bus and vanpool ridership, and the impact on vehicle miles of travel (VMT) fuel consumption, and emissions.

10.2.1 Utilization

Prior to contraflow operation, 19,420 peak direction travellers used the North Freeway during the morning peak period. After 33 months of operation, this had increased to 26,600--a 37.0 percent increase. Virtually all of this increase occurred on the contraflow lane. For the afternoon peak period, the number of peak direction travellers rose from 15,620 to 23,307 over this period--an increase of 49.2 percent. Almost all of this increase (94 percent) occurred on the contraflow lane. During the first week of opera- tion, an average of about 1,175 people used the contraflow lane during each peak period. After one year of operation, utilization equaled that for the average non-priority lane, which was about 4,390 people per peak period. By May 1982, utilization had increased to 7,800--over 80 percent greater than the average non-priority lane.

10.2.2 Bus Ridership

Immediately prior to contraflow operation, average ridership during the morning peak period was 265. After 33 months of operation (May 1982), ridership was up to 4,520--an increase of 1,600 percent. A survey of bus riders administered in December 1980 indicated that nearly half of all bus riders had moved into the North Freeway corridor after contraflow operation began. This would suggest that to a large extent this continued increase in ridership is the result of the fairly rapid population growth in the Houston region.

In addition to the contraflow lane, a number of other corridor transit improvements have been made (i.e., expanded transit service, park-and-ride lots, etc.), which further complicates the analysis of the extent to which ridership increases can be attributed to the contraflow lane. Estimates based on ridership changes for two routes existing prior to contraflow operation indicate that between 35.4 and 56.9 percent of those using transit would not have done so had the contraflow lane not been in operation. This would imply that with just expanded bus service and park-and-ride lots (i.e., without the contraflow lane) the increase in bus ridership after 33 months would have ranged from 500 to 870 percent rather than 1,600 percent. This in turn would suggest that about one-half of the increased bus ridership is attributable to the contraflow lane.

Another indication of the proportion of ridership increase attributable to the contraflow lane can be obtained from the responses of bus riders to the survey question regarding the degree of influence that the contraflow lane had in their decision to ride the bus. Survey results indicated that 57 percent would not have ridden the bus without the contraflow lane, while for an additional 33 percent, the contraflow lane was one among several factors. Only 10 percent of those surveyed indicated that they would have ridden the bus regardless of whether or not the contraflow lane was operating.

One point worth noting with respect to the effectiveness of the contraflow lane relative to that of expanded bus service and the park-and-ride lots is the mutually supportive nature of the relationship among these various improvements. For example, immediately prior to contraflow operation, there were seven morning peak period bus trips on the North Freeway with an average load factor of .75. Had bus service not been expanded, many people would not have been able to take advantage of the travel time savings offered by the contraflow lane, and the increase in ridership would have been much smaller.

On the other hand, as pointed out earlier, without the contraflow lane, the increase in ridership would have probably been less than half that which actually occurred. By implementing these improvements as a package, then, the resulting effectiveness in terms of increased bus ridership was greater than the sum of these improvements taken individually.

10.2.3 Vanpool Ridership

Although vanpool ridership on the contraflow lane was initially about twice that of bus (770 versus 400 during the morning peak period), its rate of growth over the course of the demonstration period was much lower. By the fourth month of contraflow operation, bus and vanpool ridership were about equal at 1,000 each; after 33 months, bus ridership was about 37 percent greater than vanpool ridership (4,520 versus 3,280). This represents an average growth rate of about 75 new vanpoolers per month over the first 33 months of operation. Prior to the contraflow lane, about 18 percent of all vanpools in the Houston region were operating in the North Freeway corridor. While the number of vanpools using the contraflow lane increased by about 325 percent after 33 months, since vanpooling Houston-wide had also increased by a similar amount in percentage terms, vanpools operating in the North Freeway corridor still represented about the same proportion of all Houston vanpools (19 percent). On the surface, then, it would appear that the contraflow lane had little influence on vanpool ridership in the North Freeway corridor relative to other areas in Houston.

In addition to the contraflow lane significant improvements to transit service in the North Freeway corridor were also made. It is conceivable that some of those people switching to bus would have instead chosen to vanpool had the improvements in bus service not been made. This would suggest that in the North Freeway corridor vanpooling and transit are to a certain extent competing as alternatives to auto. Evidence of this competitive relationship can be found by comparing fluctuations in the growth rate of vanpooling with changes in bus supply characteristics.

For example, when the North Shepherd Park-and-Ride lot opened in April 1980, increasing the number of buses travelling the contraflow lane by about one-third, the rate of increase in vanpool ridership decreased from an average of about 93 to 63 new vanpoolers per month. In February 1981, when utilization of the North Shepherd Park-and-Ride lot began to meet and subsequently exceed capacity, the growth rate of vanpool ridership increased to over 100 new vanpoolers per month. Between July 1981 and July 1982, the proportional growth in vanpooling in the North Freeway corridor exceeded that for the Houston area as a whole.

Because of this competitive relationship, one could argue that while vanpool ridership in the North Freeway corridor has increased at a rate no greater than that for the Houston region, if vanpools had not been allowed to use the contraflow lane, the level of vanpooling would have been lower since more people would have chosen transit. The apparently small response during the first two years of contraflow operation in terms of increased vanpooling to the travel time savings associated with the contraflow lane is also reflected in the response of vanpoolers to the question regarding the degree of influence that the contraflow lane had on their decision to vanpool. For example, only 27.1 percent of vanpool passengers and 21.3 percent of vanpool drivers indicated that they would not have vanpooled without the contraflow lane (versus 57 percent for bus riders). On the other hand, 27.1 percent of vanpool passengers and 43.1 percent of vanpool drivers indicated that they would have vanpooled whether or not the contraflow lane had been implemented (versus 10 percent for bus riders).

While it would appear that the contraflow lane had little net impact on the level of vanpooling during the first two years of operation relative to that region-wide, it did have a fairly strong impact on the timing of vanpool formation. During its first week of operation, an average of 81 vanpools used the contraflow lane. Of these, 36 (44 percent) were formed during the two months immediately prior to the start of contraflow operation.

10.2.4 Transferability of Results

The effectiveness of contraflow operation stems from the travel time savings realized by vehicles using the contraflow lane relative to those on non-priority lanes. The travel time savings associated with the North Freeway contraflow lane was substantial--40 minutes on a round trip basis during the peak hour. This fairly large savings was attributable to the length of the contraflow lane (9.6 miles), the hours of operation (both morning and afternoon peak periods), and the relatively severe congestion existing on the non-priority travel lanes. To a large extent, the transferability of results associated with effectiveness of the contraflow lane would depend on similar characteristics.

A second consideration related to effectiveness is the rapid population growth in the North Freeway corridor. Specifically, at the time that the travel surveys were administered (December 1980), 22 percent of all North Freeway travellers had moved into the corridor after the contraflow lane was opened. The corresponding proportion for bus riders (47 percent) was more than double that for all North Freeway travellers. In areas with slower growth somewhat lower increases in transit ridership might be expected.

Another consideration is related to the length of the contraflow lane. While the travel time savings associated with the contraflow lane were directly related to its length, because of limited access to the lane, the longer length also limited the number of potential users of the lane. In Houston, this lower market potential has not been a major factor in limiting the effectiveness of the lane because of the rapid growth occurring in the outlying areas of the North Freeway corridor. In other areas, though, shorter segments of contraflow operation may be more effective in term of utilization.

A final consideration affecting the transferability of those results related to the effectiveness of contraflow operation is the types of supporting improvements that are implemented in conjunction with a contraflow lane. In the North Freeway corridor, for example, if the contraflow lane had been implemented without expanding bus service and providing park-and-ride facilities, there would have been little opportunity for increased bus ridership.

10.3 COSTS AND BENEFITS

Capital costs associated with construction of the contraflow lane totaled \$2.2 million, 93 percent of which was funded by the Urban Mass Transportation Administration (UMTA) through a Section 5 capital assistance grant and, to a lesser extent, through a Section 6 Service and Methods Demonstration (SMD) grant. Local matching funds to cover the remaining costs were provided by the City of Houston and the Texas Public Transportation Fund. The Kuykendahl Park-and-Ride lot, which cost \$2.1 million to construct, was funded entirely by METRO.[1] Construction of the North Shepherd Park-and-Ride lot cost \$2.16 million, 70 percent of which was provided through Federal Aid Urban Systems funding and the remaining 30 percent by the State Department of Highways and Public Transportation.

By the end of the 18-month demonstration period, operating costs for the contraflow lane averaged \$50,200 per month (or \$602,400 on an annual basis). The SMD grant covered about half of contraflow lane operating costs during the demonstration period, after which METRO absorbed all operating costs. The costs to METRO of providing contracted bus service had reached about \$4.1 million annually by the end of the demonstration period.

Because access to the contraflow lane was limited to one entrance and exit point, the primary beneficiaries of contraflow operation (and the supporting corridor improvements as well) were suburban residents working in or near the Central Business District who either rode a bus or vanpooled to work. This group had a relatively high average income (i.e., \$38,000 versus about \$21,000 for the entire Houston region) and was not characterized as transit dependent. The primary benefit afforded to bus riders and vanpoolers

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[1]Since the effectiveness of the contraflow lane was dependent on other supporting corridor improvements, the discussion of costs and benefits is oriented towards these improvements taken as a whole.

was the decrease in travel time which, during the peak hour, amounted to a 40-minute savings on a round-trip basis. In addition, since travel in the contraflow lane was essentially free flow and not subjected to day-to-day variations in congestion levels, it is likely that reliability was also improved. Further, since additional buses were added to routes on an "as needed" basis in response to increased demand, bus riders experienced substantial increases in service frequency over the course of the demonstration.

In addition to those travellers using the contraflow lane, other peak-direction travellers in non-priority lanes also benefited initially from contraflow operation since congestion eased somewhat as a result of mode shifts to bus and vanpool. Over time, growth in the corridor eventually led to a return of congestion levels existing prior to contraflow operation. However, without contraflow operation, it is quite likely that travel conditions on the North Freeway would have deteriorated to an even lower level.

One group adversely affected by the demonstration project were those travelling in the off-peak direction during the hours of contraflow operation. When the contraflow lane was initially proposed (1975), off-peak direction traffic volumes were sufficiently low to insure that adverse impacts would be minimal. When contraflow operation was actually implemented in 1979, though, off-peak direction traffic during the peak period had increased, primarily as a result of the increasing number of firms locating in suburban areas which has led to a corresponding increase in the amount of "reverse commuting" on the North Freeway.

Initially, average off-peak direction speeds decreased considerably (from 51 to 39 miles per hour during the afternoon peak hour) when contraflow operations began. By means of various ramp control measures implemented by SDHPT, average off-peak freeway speeds rose to 45 miles per hour. For off-peak direction travellers able to use the freeway, then, the increase in travel time was minimal. However, those affected by ramp closures also experience an additional delay resulting from diversion to the frontage road.

One potential equity-related issue associated with the contraflow lane is METRO's use of revenues obtained on a regional basis (from both sales tax and fares) to subsidize relatively high quality service to a fairly narrowly defined population group characterized by relatively high income and auto ownership levels. However, if one compares the ratio of fare revenues divided by the cost of providing service on the contraflow lane (.374 for the contracted buses and operational costs associated with contraflow lane) with the corresponding systemwide figure for 1981 (.249), it would appear that contraflow service is one of METRO's better routes from a financial perspective.

APPENDIX A: SURVEY ADMINISTRATION AND QUESTIONNAIRES

The travel surveys were a major source of data supporting the evaluation of the Contraflow Lane demonstration project. Surveys were administered only once (in the fall of 1980) and information about travel behavior prior to the opening of the contraflow lane was obtained by retrospective questions. The six North Freeway user groups which were surveyed were:

1. bus passengers
2. van drivers
3. van passengers
4. peak direction auto drivers
5. peak direction auto passengers
6. off-peak direction auto drivers

In addition, van groups were asked to give detailed information about the time and mileage of their morning and afternoon trips on van logs and to plot their morning route on a map of the North Freeway corridor. A summary of the survey administrations is given in Table A-1.

A.1 BUS PASSENGERS

Contraflow bus passengers were surveyed on board the buses using a self-administered questionnaire. Only morning trips were sampled; survey forms and pencils were given by bus drivers to passengers as they entered the bus. No mail-back provision was made for returning the forms as the shortest bus ride of 15 minutes was an adequate amount of time to complete the questions. Completed questionnaires were placed in a box at the front of the bus and each box of questionnaires was returned to the Metropolitan Transit District of Harris County (METRO) at the end of the day.

There were 2,662 peak period bus passengers at the time of the survey administration in December 1980. A minimum of 384 completed, valid surveys

TABLE A-1. NORTH FREEWAY CONTRAFLOW LANE SURVEY ADMINISTRATION SUMMARY

Population	Survey Date	Survey Type	Total Number Surveyed	Number of Usable Returns	Response Rate
Peak Direction Auto Drivers	Nov 1980	License plate spotting; name/ address matching by SDHPT; mail out/mail back	2406 plates recorded; 2322 usable addresses[A]	233	9.7% of plates; 10.0% of addresses
Peak Direction Auto Passengers	Nov 1980	Mailed to drivers surveyed (as above). Drivers gave forms to their passengers who mailed them back	(see above) 673 expected maximum number of passengers reached[B]	78	3.2% of plates; 3.4% of addresses 11.6% of expected number of people reached
Off-Peak Direction Auto Driver	Nov 1980	License plate spotting; name/ address matching by SDHPT; mail out/mail back	2200 plates recorded; 1581 usable addresses[A]	164	7.5% of plates; 10.4% of addresses
Contraflow Bus Passengers	Dec 1980	Hand-out and hand-back on the buses	1016 on 22 bus runs	864[C]	85.0%
Vanpool Drivers	Dec 1980	Hand-out/hand-back at lane entrance near downtown in PM	224 (99.6% of population)	202[D]	90.2%
Vanpool Passengers	Dec 1980	In package with vanpool driver surveys (hand-out/ hand-back)	1870 (99.6% of population)	1795[D]	96.0%
Van Travel Logs (5 days asked for)	Dec 1980	In package with vanpool driver surveys	224	201-1st day 146-2nd day 139-3rd day 127-4th day 125-5th day	89.7% 65.2% 62.1% 56.7% 55.8%

TABLE A-1. (CONTINUED)

[A] Unusable addresses were either out-of-state, too far for commuting distance to Houston, company-owned cars, or rented/leased cars.

[B] Expected number of passengers reached is based on known percent of carpools on the North Freeway and average occupancy of those carpools.

[C] Bus passengers had a stake in returning questionnaires as many pleaded in the comments section for more seat capacity.

[D] Since vanpools must meet strict requirements to be registered to use the contraflow lane, the response rate may be higher in this case than one in which a follow-up to non-respondents is difficult or impossible.

were required to meet the agreed upon level of statistical significance.[1] The response rate per sampled bus was expected to be 80 percent, so with an average ridership per bus of 40 people, a minimum of 12 buses needed to be sampled. Since bus drivers were responsible for questionnaire distribution, the marginal cost of oversampling was nil and 26 morning bus runs were selected for surveying. Every third bus for each route was selected except for Route 202 which had only two runs per peak period, and thus, had a 50 percent sampling rate. Four of the 26 selected bus runs were never surveyed due to problems with instructions or materials.

The final returns (listed by route in Table A-2) totaled 868 completed questionnaires from 1,016 passengers on 22 bus runs. This was an 85 percent return rate for people surveyed and a 33 percent response rate for the entire bus passenger population. Bus passenger survey responses were weighted by route so that, unless indicated, all summaries of bus passenger data given in this report represent the actual proportions of passengers for each route. This was an important component of the survey data analysis since the return rates by route varied and the characteristics of bus passengers such as access mode, miles to the bus stop or parking lot, and total travel distance were expected to vary by route.

A.2 VANPOOLERS

The vanpool surveys were administered December 9-11, 1980 using a hand-out method at the afternoon contraflow lane entrance. Most materals were collected by "hand-back" at the lane entrance two days later, however, some materials were mailed back in a stamped envelope provided by METRO. The package of materials given to each vanpool included:

1. a van driver survey;
2. 11 van passenger surveys;
3. 5 van logs
4. a map of the North Freeway corridor.

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[1] Ninety-five percent accuracy of predicting population characteristics within a ± 5 percent error.

TABLE A-2. CONTRAFLOW BUS ON-BOARD SURVEY RETURNS

Survey Administration	Bus Route Number	Bus Runs Surveyed	Peak Period Ridership	Returned Questionnaires	Weighting Factor
Dec. 4, 1980	107	4	349	158	2.21
Dec. 4, 1980	112	1	95	28	3.39
Dec. 9, 1980	202	8	946	301	3.14
Dec. 10, 1980	201	6	792	250	3.17
Dec. 11, 1980	203	3	480	127	3.78
TOTAL		22	2,662	864	

Each of the materials in one package had identical serial numbers so that data could be cross-referenced during the analysis.

About 20 telephone calls were received from van drivers or corporate vanpool coordinators over the three-day period following survey distribution. Some of the calls reflected concern by drivers that they either could not complete and return the information by that Friday, or that they did not know the requested information. Other calls were from corporate coordinators challenging METRO's need to know certain information or questionning the relevance of some information for the contraflow lane. The purpose and importance of the survey were explained to these callers, and they were asked to complete as much of the questionnaire as they had information for and was not against their company's policy to reveal.

Just as in the bus passenger survey administration, there was no marginal cost for oversampling vanpools. Every vanpool (except one, due to an insufficient number of prepared packages) received the van survey materials. The return rate for vanpool materials is listed in Table A-1.

A.3 AUTO DRIVERS AND PASSENGERS

Peak period auto drivers and passengers on the North Freeway were surveyed by the two-step process of license plate spotting and then questionnaire mail-out to the names and addresses found in the State's license plate registration files. All plates were spotted on November 13, 1980 between 6 and 8:30 AM. Approximately 2,400 plates were recorded from peak direction (southbound) traffic and about 2,200 plates from the off-peak direction traffic. Plates were recorded for a representative distribution of vehicles across all travel lanes and only Texas plate numbers were recorded.

The State Department of Highways and Public Transportation (SDHPT) had agreed to assist METRO in this data collection effort by matching plate registrations to owner's names and addresses. Despite the fact that there were no problems with these procedures during the survey pretest in October, there were several problems during the actual survey administration. These problems probably had a substantial impact on the response rate.

The first problem was that the SDHPT was unable or unwilling to complete the name/address matching procedures. Instead of returning to METRO printed address labels (as was done in the pretest), SDHPT gave all information stored for each listed plate. Typists had to be hired to read sheets of data, find names and addresses, and type mailing labels. The resulting time lag between use of the North Freeway and receipt of a questionnaire probably had a negative impact on the response rate.

The second problem was that information for 597 off-peak direction autos was listed by SDHPT as being for peak direction autos. Thus, 597 people were mailed incorrect survey forms. Information on questionnaires identified as the "wrong form" was transferred (to the extent the questions were identical) to the format of the correct form and was included in the data analyses.

Out of the 2,406 peak direction license plates which were recorded, 2,322 usable addresses were returned by SDHPT. Out of the 2,200 off-peak direction plates, there were 1,581 usable addresses. In addition to the problems summarized above, reasons for unusable license plate information included:

1. no data returned by the State (possibly due to a misread or incorrectly transcribed number);

2. data not yet reported by the county to the State;

3. corporate-owned vehicle;

4. auto-rental agency owned vehicle; and

5. address further from Houston than a reasonable commute.

The response rates for both driver and passenger surveys are listed in Table A-1.

A.4 SAMPLE QUESTIONNAIRES

The following are sample questionnaires from the surveys described above.

METRO

METRO is conducting an evaluation of the North Freeway Contraflow Lane to determine its impacts on bus passengers. As a part of the evaluation, we request that you complete this questionnaire. Your responses will be of great value to the study and will be held in strict confidence.

After you have completed this questionnaire, please return it to the driver as you leave the bus. Thank you for your cooperation.

1. What is the primary purpose of the trip you are making on this bus?

   ____ work
   ____ other (specify): ____________

2. In the past five workdays, how many ONE-WAY trips by bus did you make on the North Freeway?

   Towards Downtown in the morning ________ trips by bus
   Out of Downtown in the afternoon ________ trips by bus

3. In the past five workdays, if you made morning or afternoon trips on the North Freeway by a means other than bus, what alternative travel means did you use?

   Indicate number of one-way trips:

AM	PM	
____	____	drove my car with no passengers
____	____	drove my car with ____ passenger(s)
____	____	auto passenger with ____ other people
____	____	vanpool
____	____	motorcycle, bicycle, taxi, other

4. Where did you board your bus this morning?

   ____ (Route 202) Kuykendahl Lot
   ____ (Route 201) N. Shepherd Lot
   ____ (Route 203) Church of Christ Lot-Champions
   ____ (Route 107) FM 1960 east of Steubner-Airline Rd.
   ____ (Route 107) FM 1960 west of Steubner-Airline Rd.
   ____ (Route 112) FM 149 north of FM 1960
   ____ (Route 112) FM 149 south of FM 1960

5. How did you travel to meet your bus this morning?

   ____ walk
   ____ drove my car with no passengers
   ____ drove my car with ____ passengers
   ____ dropped off by someone continuing to another destination
   ____ driven by someone who rode the bus with me
   ____ driven by someone who would not have otherwise made the trip
   ____ other

6. How many miles (one-way) did you travel from your home to where you met the bus?

   ________ miles one-way

7. At what time did you board the bus this morning and at what time will you board a bus this afternoon? (Please indicate the times to the nearest quarter hour; i.e., 7:00, 7:15, 7:30, 7:45. Give your best estimate if you are not positive about the time this afternoon. Write NB if you will not take the bus this afternoon.)

   ________ AM ________ PM

8. Where is your final destination this morning?

   ____ Downtown
   ____ Greenway Plaza
   ____ Post Oak/Galleria area
   ____ Texas Medical Center
   ____ Other (specify ZIP code): ____________

9. How will you travel to your final destination (work) when you get off the bus this morning?

   ____ walk
   ____ another bus: Route Name or No.________
   ____ taxi
   ____ other (specify) ____________

10. Please estimate your total "door-to-door" travel time for this ...

    morning's trip: ____ minutes one-way
    afternoon's trip: ____ minutes one-way

11. For this morning's and this afternoon's travel, how many minutes of your total travel time was spent for each of the following?

Minutes in AM	Minutes in PM	
____	____	Time between home and where you board (or leave) the bus
____	____	Waiting time at the bus stop
____	____	Time between getting off (or on) the bus and work

12. Which of the following did you use to pay your fare for this bus trip?

    ____ cash
    ____ commuter card (monthly pass)
    ____ ticket from a 40-ride book
    ____ other (specify): ____________

13. If you regularly travel by bus, how much money do you feel you are saving each month by riding the bus instead of driving?

    $ ________ per month OR ____ not sure

14. When did you begin travelling on the North Freeway by bus?

    ________ month ________ year

15. How did you usually make this trip before you began to ride the bus on Contraflow?

    ____ I did not make this trip before I began riding the bus on Contraflow
    ____ Drove my car with no passengers
    ____ In a carpool with ____ other people
    ____ Bus (non-Contraflow)
    ____ Vanpool
    ____ Motorcycle, bicycle, taxi, other

    If you were in a carpool, were any people in this carpool members of your household?

    ____ yes ____ no

16. If you previously travelled by a means other than Contraflow bus, what was your average one-way travel time from home to your final destination (work)?

    ________ minutes one-way

    ... your average one-way trip distance?

    ________ miles one-way

17. Do you believe the Contraflow Lane has increased, decreased, or had no effect on:

Large increase	Small increase	No effect	Small decrease	Large decrease	Not sure	
____	____	____	____	____	____	the number of delays you experience on the freeway
____	____	____	____	____	____	morning inbound and afternoon outbound freeway congestion
____	____	____	____	____	____	morning outbound and afternoon inbound freeway congestion

18. How many minutes, if any, do you believe you typically save by travelling in the Contraflow Lane instead of the regular North Freeway lanes?

    ________ minutes in the morning
    ________ minutes in the afternoon

19. How important was having the contraflow lane in influencing you to ride the bus?

    ____ most important; I would not have ridden the bus otherwise
    ____ important; it was one of several factors
    ____ not important; I would have ridden the bus anyway

20. On a scale of 1 to 5 where 1 means "extremely important," 3 means "neutral" and 5 means "extremely unimportant," please rate the importance of each of the following factors in determining your travel means on the North Freeway:

1 extremely important	2 important	3 neutral	4 unimportant	5 extremely unimportant	
___	___	___	___	___	save time
___	___	___	___	___	save money
___	___	___	___	___	save wear on auto
___	___	___	___	___	dislike driving
___	___	___	___	___	dependability
___	___	___	___	___	convenience
___	___	___	___	___	safety
___	___	___	___	___	flexibility to determine own travel schedule
___	___	___	___	___	privacy
___	___	___	___	___	option to make stops on the way to or home from work

21. From where did you first obtain bus schedules and information prior to riding the bus? (CHECK ONLY ONE.)

___ I did not obtain schedules and information

___ my employer

___ the METRO information center

___ a friend

___ other (specify) ____________

22. Do you believe that travelling in a bus on the Contraflow Lane is more safe, less safe, or no different than travelling in a bus in regular freeway traffic?

___ Contraflow makes bus travel safer

___ There is no difference

___ Contraflow makes bus travel less safe

___ Not sure

23. If you need to leave work later than when the last Contraflow bus leaves from your office, what alternative travel means do you use?

___ drive my car both ways

___ ride in someone else's car both ways

___ picked up in the evening

___ company car

___ non-Contraflow bus

___ other (specify) ____________

24. In your opinion, are there currently too few vehicles using the Contraflow Lane to justify the project?

___ yes

___ no

25. Which of the following would you favor or disfavor for increasing the number of people using the Contraflow Lane? (CHECK ONE IN EACH ROW.)

Strongly favor	Favor	Neutral	Disfavor	Strongly disfavor	Not Sure	
___	___	___	___	___	___	A. More marketing of existing bus service
___	___	___	___	___	___	B. More bus service on existing routes
___	___	___	___	___	___	C. Construction of more park and ride lots
___	___	___	___	___	___	D. Allow carpools on Contraflow Lane
___	___	___	___	___	___	E. Encourage more vanpooling

26. Which one of the above (from Question 25) do you think would be most important in increasing the number of people using the Contraflow Lane? CIRCLE the appropriate letter.

A B C D E

27. What is your home ZIP Code? ____________

28. How long have you lived at your current address?

______ years ______ months

29. What is your occupation?

___ sales ___ service worker

___ executive ___ student

___ professional ___ homemaker

___ shop-factory worker ___ retired

___ clerical-office ___ unemployed

___ craftsperson-foreman ___ other

30. If you are employed, how long have you been with your current employer at your current location?

______ years ______ months

31. What is your age?

___ less than 16 ___ 46-55

___ 16-25 ___ 56-64

___ 26-35 ___ 65 and older

___ 36-45

32. Are you . . . .?

___ male ___ female

33. Are you a licensed driver?

___ yes ___ no

34. If yes, could you use a vehicle (auto, van, pickup truck, or recreational vehicle (RV)) every day without inconvenience to other household members?

___ Yes, I always have a vehicle available

___ No, I never or rarely have a vehicle available

___ No, using a vehicle every day would occasionally be inconvenient to family members

35. How many vehicles (autos, vans, pick-ups or RV's) are owned by your household?

______ vehicles

36. How many licensed drivers (including yourself) are there in your household?

______ drivers

37. How has riding the bus affected the number of vehicles your household owns? (CHECK ONLY ONE.)

___ No effect

___ Delayed replacing an existing vehicle

___ Avoided buying another vehicle

___ Sold a vehicle and did not replace it

___ Will probably sell a vehicle.

38. If you used to drive to work before you began riding the bus, is the vehicle you drove now driven by others in your household while you are at work?

___ There is no extra vehicle at home as a result of my riding the bus.

___ No, the vehicle is not driven by others.

___ Yes, but for fewer miles than I would have driven it.

___ Yes, for about the same number of miles I would have driven.

___ Yes, but for more miles than I would have driven.

___ Yes, but I am not sure for how many miles.

39. In what range is your annual combined household income? (Your response is strictly confidential.)

___ $0-9,999 ___ $25,000-29,999

___ $10,000-14,999 ___ $30,000-39,999

___ $15,000-19,999 ___ $40,000-59,999

___ $20,000-24,999 ___ $60,000 or more

COMMENTS OR EXPLANATIONS:

THANK YOU FOR YOUR COOPERATION.

METRO
Metropolitan Transit Authority
P.O. Box 61429 Houston, Texas 77208 (713) 225-1151

Contraflow Van Drivers and Passengers

As users of the Contraflow Lane, Metro requests your assistance in completing the enclosed questionnaires. The North Freeway Contraflow Lane is the only project in the United States in which vanpoolers are included as users of a Contraflow Lane. Therefore, your responses are important to the evaluation of this project.

In this package are 11 vanpool passenger surveys and one driver survey and log. Please distribute a passenger survey to each rider in your vanpool today and any additional riders who are in your vanpool tomorrow. The driver survey and log should be filled out by the principal vanpool driver.

Please return the completed passenger and driver surveys along the first day log, either Thursday or Friday afternoon to the Contraflow personnel who will be stationed at the Lane entry (where you received this package). Drivers should mail the remaining log sheets to Metro in the enclosed postage paid envelope.

Your comments and recommendations from previous surveys have helped us in planning improvements to Contraflow operation. We appreciate your cooperation in this survey.

Van Drivers:

METRO
METROPOLITAN TRANSIT AUTHORITY

We would appreciate your completing the following questionnaire and log to help in the evaluation of the North Freeway Contraflow Lane. The information you provide is anonymous and will be kept in strict confidence

It is possible that due to the structure of your vanpool, some of the questions may not be applicable, or you may not know the information requested. For these questions, please respond with "NA"--not applicable or "DK"--don't know. It is not necessary to contact your company's vanpool coordinator.

Please have your questionnaire and first day log ready to return to Contraflow personnel at the Lane entry Thursday afternoon. (Note: Passengers should return surveys for you to hand in Wednesday and Thursday afternoons.) Additional days of vanpool logs should be completed at your option and mailed to Metro in the enclosed envelope.

Thank you for your cooperation.

Today is: December ________

1. From where does your van leave in the morning?

   major intersection ________________

   ZIP ________

2. Where is your vanpool destination?

   ____ Downtown

   ____ Galleria/City Post Oak

   ____ Greenway Plaza

   ____ Texas Medical Center

   ____ Brown & Root (Clinton)

   ____ American General Center

   ____ Other (specify) ________________

3. What is the average daily parking fee paid to park the van at w

   $ ________ or ____ free

   Is this a preferential (special location) or guaranteed spot assigned to you because you pool?

   ____ yes

   ____ no

   Is the cost subsidized by an employer or employer association?

   ____ yes

   ____ no

4. If you work downtown, do you pick up your passengers in the afternoon along the street?

   ____ yes

   ____ no

   If yes, would you use designated on-street vanpool loading zones if these zones were located within reasonable proximity to current pickup points?

   ____ yes

   ____ no

5. Do you usually use the Contraflow Lane...

   yes no

   ___ ___ ...in the morning?

   ___ ___ ...in the afternoon?

6. Would your vanpool use the Crossover near I-610 to exit the Contraflow Lane if it were opened for everyday use? This access would not permit entry or exit from I-610, but would permit alternative access south of I-610.

   ____ yes

   ____ no

7. What is the total number of people registered for this vanpool?

   ________ people

   How many of these people, if any, live in the same household?

   ____ none

   or

   ________ people in ____ households

8. Who is/are the employers for members of your vanpool including yourself? (List your own employer first.)

Employer name	Number in Vanpool who work there
____	____
____	____
____	____

9. Please describe the owning/leasing arrangement for this van.

____ employer provides van

____ I own the van

____ third party (not employer or driver) provides van

____ other (specify) ____

What is the make, model and year of the van?

____

10. Do you pay a fare?

____ yes

____ no

11. Do you retain part of the fares collected from your passengers?

____ yes

____ no

If yes, please describe the arrangement (such as, keeping fares from the tenth and eleventh passengers).

12. Do you have free use of the van evenings and weekends?

____ yes

____ no

If yes, how many free miles are you allowed per month?

____ miles

If you pay per mile for personal use of the van after the free miles are used, what do you pay?

____ cents per mile

13. Who sets the passenger fares?

____ my employer

____ I do (the driver)

____ the "third party" which provides the van

____ other (specify) ____

14. Do all passengers pay the same fare?

____ yes

____ no

15. What was the total amount of fares collected from all passengers (including yourself if you pay a fare) last month?

$ ____ from ____ vanpool members

16. How many miles was the van driven last month for commuting and personal use?

____ miles for commuting, and

____ miles for personal use

17. Please check the vanpool functions for which you are responsible (CHECK AS MANY AS APPLY):

____ Fare collection

____ Gasoline purchase

____ Cleaning of van

____ Arranging for maintenance

____ Recruiting new passengers

____ Securing backup drivers

____ Arranging alternative travel means when van is unavailable.

18. Approximately how many hours per month do you spend on the above tasks? (Do not count time spent actually driving the vanpool.)

____ hours

19. Do you personally incur any cost in operating the vanpool? (Do not include any cost for which you are reimbursed.)

____ yes

____ no

If yes, indicate what the expense is and what the cost was last month.

____

____

20. How do people in your vanpool get to work when the regular van is unavailable?

____ We are provided a backup van

____ Several carpools

____ Bus

____ There is no organized alternative; it is each person for himself/herself.

____ Other (specify) ____

21. When was this vanpool formed? (That is, the earliest date for which some of the current group started riding together in a van. Some of the original passengers may have stopped riding since this date.)

_____ month _____ year

How many people were in the vanpool at that time?

_____ people

22. How was the vanpool group first organized?

___ By my employer or employer organization
___ I found the riders
___ Residential Developer
___ Other (specify) ___________

How are new people found to replace those who leave the vanpool?

___ By my employer or employer organization
___ I find the riders
___ Residentail Developer
___ Other (specify) ___________

23. Since your vanpool was formed, how many people have stopped riding?

_____ people

How many new people have started riding?

_____ people

24. When did you begin making this trip by vanpool (as either a driver or passenger)?

_____ month _____ year

25. How did you usually make this trip before you began vanpooling?

___ I did not make this trip before I began vanpooling
___ Drove my car with no passengers
___ In a carpool with _____ other(s)
___ Bus: Route name or No. ___________
___ Motorcycle, bicycle, taxi, other

26. If you were in a carpool, did you...?

___ always drive
___ share driving
___ always ride

How many people, if any, in this carpool were members of your household?

_____ none

or

_____ people

If you previously carpooled, what was your total one-way travel distance from home to work (including miles to pick up passengers)?

_____ miles one-way

27. From which of the following did you first learn about vanpooling?

___ employer program
___ Contraflow Lane publicity
___ CarShare promotion
___ a friend or neighbor
___ co-worker
___ other (specify) ___________

28. On a scale of 1 to 5 where 1 means "extremely important," 3 means "neutral," and 5 means "extremely unimportant," please rate the importance of each of the following factors in determining your travel means on the North Freeway:

Extremely Important 1	Important 2	Neutral 3	Unimportant 4	Extremely Unimportant 5	
___	___	___	___	___	save time
___	___	___	___	___	save money
___	___	___	___	___	save wear on auto
___	___	___	___	___	like to drive
___	___	___	___	___	other members of my household need auto
___	___	___	___	___	incentives in employer-sponsored program
___	___	___	___	___	dependability
___	___	___	___	___	convenience
___	___	___	___	___	safety
___	___	___	___	___	flexibility to determine own travel schedule
___	___	___	___	___	privacy
___	___	___	___	___	option to make stops on the way to or home from work

29. Please rate the importance of each of the following in influencing you to be a van driver. Check "NA" for each which is not available to you.

Extremely Important	Important	Neutral	Unimportant	Extremely Unimportant	N.A.	
___	___	___	___	___	___	free commute trip
___	___	___	___	___	___	use of van after work or weekends
___	___	___	___	___	___	use of van during the day
___	___	___	___	___	___	keep part of passenger fares

30. How important was having the Contraflow Lane in influencing you to join a vanpool?

___ Most important; I would not have joined a vanpool otherwise.

___ Important; it was one of several factors

___ Not important; I was already in a vanpool or would have joined one anyway.

31. Do you believe the Contraflow Lane has increased, decreased, or had no effect on:

Large Increase	Some Increase	No Effect	Some Decrease	Large Decrease	Not Sure	
___	___	___	___	___	___	The number of delays you experience on the freeway
___	___	___	___	___	___	Morning inbound and afternoon outbound freeway congestion (peak direction)
___	___	___	___	___	___	Morning outbound and afternoon inbound freeway congestion (offpeak direction)
___	___	___	___	___	___	The total number of people travelling on the North Freeway including those on the Contraflow Lane
___	___	___	___	___	___	Average freeway travel speeds of all people
___	___	___	___	___	___	Your operating costs on the freeway
___	___	___	___	___	___	Driver attentiveness (safer driving habits)
___	___	___	___	___	___	Traffic accidents (on the CFL side)
___	___	___	___	___	___	Traffic accidents (not on the CFL side)
___	___	___	___	___	___	Fuel consumption
___	___	___	___	___	___	Air pollution from freeway vehicles

32. How many minutes, if any, do you believe this vanpool typically saves by using the Contraflow Lane instead of the regular lanes?

________ minutes in the morning

________ minutes in the afternoon

33. Do you believe driving a van in the Contraflow Lane is more safe, less safe, or no different from driving a van in regular freeway lanes?

___ Contraflow driving is safer

___ There is no difference

___ Contraflow driving is less safe

___ Not sure.

34. Do you believe the following have increased, decreased, or had no affect on this vanpoool's travel time on the North Freeway?

Large Increase	Some Increase	No Effect	Some Decrease	Large Decrease	Not Sure	
___	___	___	___	___	___	Ramp metering signals
___	___	___	___	___	___	Temporary ramp closures (barricades placed at selected entry ramps)

35. In your opionion, are there currently too few vehicles using the Contraflow Lane to justify the project?

___ yes

___ no

36. Which of the following would you favor or disfavor for increasing the number of people using the Contraflow Lane?

Strongly Favor	Favor	Neutral	Disfavor	Strongly Disfavor	Not Sure	
___	___	___	___	___	___	A. More marketing of existing bus service
___	___	___	___	___	___	B. More bus service on existing routes
___	___	___	___	___	___	C. Construction of more park-and-ride lots
___	___	___	___	___	___	D. Allow carpools on the CFL
___	___	___	___	___	___	E. Encourage more van-pooling
___	___	___	___	___	___	F. Ease requirements for vanpools to become authorized CFL users

37. Which one of the above (from Question 36) do you most strongly favor for increasing the number of people using the Contraflow Lane? (Circle the appropriate letter.)

A B C D E F

38. If contraflow priority treatment were ended, would you continue to vanpool?

___ yes

___ no

___ not sure

39. If you could no longer travel in the vanpool, by what method would you make this trip?

____ Driving my car with no passengers
____ Driving my car with passenger(s)
____ As a passenger in a car
____ Bus: Route Name or No. ______________
____ Motorcycle, bicycle, taxi, other
____ I would not make the trip

40. If you were to drive by yourself directly between home and work, what would your average total morning travel time be?

________ minutes one-way

...your average total afternoon travel time?

________ minutes one-way

41. If you were to drive by yourself between home and work, how many miles (one-way), would the trip be?

________ miles one-way

42. How much daily flexibility are you allowed in the time you begin and end work each day?

____ none
____ up to 15 minutes
____ 15 to 29 minutes
____ 30 to 59 minutes
____ 1 to 2 hours
____ more than 2 hours or complete flexibility

43. Please indicate the number of days you did not drive the vanpool last month for each of the following reasons:

Number of days

__________ sick leave
__________ business trip
__________ vacation
__________ company holiday
__________ van inoperable
__________ other (specify): ______________

44. How many licensed, Contraflow-authorized back-up drivers does your vanpool have?

________ back-up driver(s)

Please describe the benefits or compensation given to the back-up driver(s).

____
____
____

45. As part of the evaluation of fuel savings resulting from Contraflow Lane vanpooling, it is important to learn the fuel economy of the vehicles used previously and currently for your commuting trip.

How many miles per gallon does your van get?

________ mpg

What was the average miles per gallon of the vehicle or vehicles you previously used to make your work trip?

________ mpg

46. Including yourself how many persons in your household are in each the following categories?

________ preschool
________ school age
________ employed part- or full-time
________ unemployed or retired

47. How many vehicles (autos, vans, pick-up trucks, and recreational vehicles--RV's) are owned by or available to your household?

________ vehicles

48. How many licensed drivers (including yourself) are there in your household?

________ drivers

49. Could you use a vehicle (auto, van, pick-up, or RV) every day without inconvenience to other household members?

____ Yes, I always have a vehicle available.
____ No, I never or rarely have a vehicle available
____ No, using a vehicle every day would occasionally be inconvenient to other household members.

50. How has vanpooling affected the number of vehicles your household owns? (CHECK ONLY ONE.)

____ no effect
____ delayed replacing an existing vehicle
____ avoided buying another vehicle
____ sold a vehicle and did not replace it
____ will probably sell a vehicle

51. If you used to drive to work before you began vanpooling, is the vehicle you drove now driven by others in your household while you are not using it?

- ____ There is no extra vehicle at home as a result of my vanpooling.
- ____ No, the vehicle is not driven by others.
- ____ Yes, but for fewer miles than I would have driven it.
- ____ Yes, but for about the same miles I would have driven it.
- ____ Yes, but for more miles than I would have driven it.
- ____ Yes, but I am not sure for how many miles.

52. What is your occupation?

- ____ sales
- ____ executive
- ____ professional
- ____ shop-factory worker
- ____ clerical-office
- ____ craftsperson-foreman
- ____ service worker
- ____ manager
- ____ other ____________________

53. How long have you lived at your current address?

________ years ______ months

54. How long have you worked for your current employer at your current location?

________ years ______ months

55. What is your age?

- ____ under 16
- ____ 16-25
- ____ 26-35
- ____ 36-45
- ____ 46-55
- ____ 56-64
- ____ 65 and older

56. Are you...

- ____ male
- ____ female

57. In what range is your annual combined household income? (This information is needed only for statistical purposes.)

- ____ I prefer not to say
- ____ I do not know
- ____ $ 0- 9,999
- ____ $10,000-14,999
- ____ $15,000-19,999
- ____ $20,000-24,999
- ____ $25,000-29,999
- ____ $30,000-39,999
- ____ $40,000-59,999
- ____ $60,000 or more

COMMENTS OR EXPLANATIONS:

THANK YOU VERY MUCH FOR YOUR COOPERATION.

010219

Vanpool Passengers:

METRO

METROPOLITAN TRANSIT AUTHORITY

We would appreciate your filling out this questionnaire to help in the evaluation of the North Freeway Contralow Lane. The information you proivde is anonymous and will be kept in strict confidence. METRO cannot link answers to any particular person who has returned a questionnaire.

It is possible that due to the structure of your vanpool, some of the questions may not be applicable, or you may not know the information requested. For these questions, please respond with "NA" -- not applicable -- or "DK" -- don't know.

Please give the completed questionnaire to your driver so that he or she may return all questionnaires to the Contraflow personnel stationed at the Lane entry Wednesday and Thursday afternoon.

THANK YOU FOR YOUR COOPERATION.

Today is: December ________

1. In the past five workdays, how many days did you ride in the vanpool?

   AM Period ____ days PM Period ____ days

2. If you answered less than five trips for either AM or PM (in question 1), please indicate the number of one-way trips made by each of the following:

   No. of Trips

   AM PM

   ___ ___ Drove my car with no passengers
   ___ ___ Drove my car with ____ passenger(s)
   ___ ___ Rode in a car with ____ other people
   ___ ___ Bus: Route Name or No. ________
   ___ ___ Motorcycle, bicycle, taxi, other

3. How will/did you travel to meet your van the morning the first van log is/was completed?

   ____ I will be picked up at home
   ____ drive by myself
   ____ drive with others meeting the van
   ____ ride with others meeting the van
   ____ dropped off by someone going that way
   ____ dropped off by someone who would not have otherwise made the trip
   ____ walk, bicycle, other ____________

4. If you are not met at home:

   ...how many minutes, if any, did you wait for your van Wednesday morning past the scheduled meeting time?

   ________ minutes

   ...how many minutes (one-way) did it take to travel from home to the meeting place?

   ________ minutes one-way

   ...how many miles (one-way) did you travel from home to the meeting place?

   ________ miles (one-way)

5. In the morning, how many people usually join the van group after the stop at which you are met?

   ________ people

6. How do you travel from where your van drops you off in the morning to where you work?

   ____ walk
   ____ bus
   ____ taxi
   ____ other (Specify): ____________

   How many minutes does it take?

   ________ minutes

7. How many minutes, if any, did you wait for your van yesterday afternoon past the scheduled meeting time?

   ________ minutes

8. In the past month, how many mornings was your vanpool late to pick you up by ...

_______ five to ten minutes?

_______ more than teo minutes?

9. In the past week, how many mornings (oo which you travelled hy vanpool) did you arrive at work late?

_______ days

10. Does your employer contrihute part of your monthly vanpool fare?

___ yes

___ no

What did you personally pay to ride io the van last month (excluding any employer subsidy).

$ _______ for the month

___ I did not pay

11. When did you hegin making this trip hy vanpool?

_______ month _______ year

12. How did you usually make this trip before you began vanpooling?

___ I did not make this trip before I began vanpooling

___ Drove my car with no passengers

___ In a carpool with _____ other(s)

___ Bus: Route Name or No. _______

___ Motorcycle, bicycle, taxi, other

13. If you were in a carpool, did you...

___ always drive?

___ share driving?

___ always ride?

How many people, if any, in this carpool were members of your bousebold?

_____ none

or

_______ people

If you previously carpooled, what was your total one-way trip distance from home to work (including miles to pick up passengers)?

_______ miles one-way

14. From which of the following did you first learn about vanpooling?

___ employer program

___ Contraflow Lane publicity

___ CarShare promotion

___ a friend or neighbor

___ co-worker

___ other (specify) ____________________

15. On a scale of 1 to 5 where 1 means "extremely important," 3 meaos "neutral," and 5 means "extremely unimportant," please rate the importance of each of the following factors in determining your travel means on the North Freeway:

Extremely Important 1	Important 2	Neutral 3	Unimportant 4	Extremely Unimportant 5	
___	___	___	___	___	save time
___	___	___	___	___	save money
___	___	___	___	___	save wear on my auto
___	___	___	___	___	dislike driving
___	___	___	___	___	incentives in employer-sponsored program
___	___	___	___	___	dependahility
___	___	___	___	___	convenience
___	___	___	___	___	safety
___	___	___	___	___	flexihility to determine own travel schedule
___	___	___	___	___	privacy
___	___	___	___	___	option to make stops on the way to or home from work

16. How important was having the Contraflow Lane in influencing you to join a vanpool?

___ most important; I would not have joined a vanpool otherwise

___ important; it was one of several factors

___ not important; I was already in a vanpool or would have joined one anyway

17. Are you a Contraflow-authorized back-up driver?

___ yes

___ no

If yes, describe the benefits or compensation you receive for this.

____

____

____

18. How many minutes do you believe this vanpool is saving by travelling on the Contraflow Lane instead of the regular North Freeway lanes?

_______ minutes in the morning

_______ minutes in the afternoon

19. Do you believe that travelling in a van in the Contraflow Lane is more safe, less safe, or no different from travelling in a van on the regular North Freeway lanes?

___ Contraflow travel is safer

___ There is no difference

___ Contraflow travel is less safe

___ Not sure

20. In your opinion, are there currently too few vehicles using the Contraflow Lane to justify the project?

___ yes

___ no

21. Which of the following would you favor or disfavor for increasing the number of people using the Contraflow Lane?

Strongly Favor	Favor	Neutral	Disfavor	Strongly Disfavor	Not Sure	
___	___	___	___	___	___	A. More marketing of existing bus service
___	___	___	___	___	___	B. More bus service on existing routes
___	___	___	___	___	___	C. Construction of more park-and-ride lots
___	___	___	___	___	___	D. Allow carpools on the CFL
___	___	___	___	___	___	E. Encourage more vanpooling
___	___	___	___	___	___	F. Ease requirements for vanpools to become authorized CFL users

22. Which one of the above (from Question 21) do you most strongly favor for increasing the number of people using the Contraflow Lane? (Circle the appropriate letter.)

A B C D E F

23. If contraflow priority treatment were ended, would you continue to vanpool?

___ yes

___ no

___ not sure

24. If you could no longer travel in the vanpool, by what method would you make this trip?

___ Driving my car with no passengers

___ Driving my car with passengers(s)

___ As a passenger in a car

___ Bus: Route Name or No. ___________

___ Motorcycle, Bicycle, Taxi, other

___ I would not make this trip

25. If you were to drive by yourself directly between home and work, what would your average total morning travel time be?

_______ minutes one-way

...your average total afternoon travel time?

_______ minutes one-way

26. If you were to drive by yourself between home and work, how many miles (one-way) would the trip be?

_______ miles one-way

27. How much daily flexibility are you allowed in the time you begin and end work each day?

___ none

___ up to 15 minutes

___ 15 to 29 minutes

___ 30 to 59 minutes

___ 1 to 2 hours

___ more than 2 hours or complete flexibility

28. How often do you need a car at work to perform work-related tasks during the day?

___ once a month or less

___ 2-3 times per month

___ once a week

___ 2-3 times per week

___ 4 or more times per week

29. Please indicate the number of days you did not ride in your vanpool last month for each of the following reasons:

Number of days

_______ sick leave

_______ business trip

_______ vacation

_______ company holiday

_______ van inoperable

_______ needed my car

_______ not ready on time

_______ other (specify): ___________

30. What was the average miles per gallon of the vehicle or vehicles you previously used to make your work trip?

_______ mpg

31. Including yourself, how many persons in your household are in each of the following categories?

_______ pre-school

_______ school age

_______ employed part- or full-time

_______ unemployed or retired

32. How many vehicles (autos, vans, pick-up trucks, or recreational vehicles--RV's) are owned by or available to your household?

_____ vehicles

33. Are you a licensed driver?

____ yes

____ no

34. If yes, could you use a vehicle (auto, van, pickup truck or RV) every day without inconvenience to other household members?

____ Yes, I always have a vehicle available.

____ No, I never or rarely have a vehicle available.

____ No, using a vehicle every day would occasionally be inconvenient to family members

35. How many licensed drivers (including yourself) are there in your household?

_____ drivers

36. How has vanpooling affected the number of vehicles your household owns? (CHECK ONLY ONE.)

____ no effect

____ delayed replacing an existing vehicle

____ avoided buying another vehicle

____ sold a vehicle and did not replace it

____ will probably sell a vehicle

37. If you used to drive to work before you began vanpooling, is the vehicle you drove now driven by others in your household while you are at work?

____ There is no extra vehicle at home as a result of my vanpooling.

____ No, the vehicle is not driven by others.

____ Yes, but for less than the total mileage I would have driven.

____ Yes, for about the same number of miles I would have driven.

____ Yes, but for more than the total mileage I would have driven.

____ Yes, but I am not sure for how many miles

38. What is your occupation?

____ sales

____ executive

____ professional

____ craftsperson-foreman

____ clerical-office

____ shop-factory worker

____ service worker

____ manager

____ other

39. For what company do you work?

____

40. How long have you worked for this company at your current location?

_____ years _____ months

41. How long have you lived at your current address?

_____ years _____ months

42. What is your age?

____ less than 16

____ 16-25

____ 26-35

____ 36-45

____ 46-55

____ 56-64

____ 65 and older

43. Are you . . .?

____ male

____ female

44. In what range is your annual combined household income? (This information is needed only for statistical purposes.)

____ I prefer not to say

____ I do not know

____ \$ 0- 9,999

____ \$10,000-14,999

____ \$15,000-19,999

____ \$20,000-24,999

____ \$25,000-29,999

____ \$30,000-39,999

____ \$40,000-59,999

____ \$60,000 or more

COMMENTS OR EXPLANATIONS:

____

____

____

____

____

____

____

THANK YOU VERY MUCH FOR YOUR COOPERATION.

VANPOOL TRAVEL LOG

DAY:__________ DATE:________________

Morning trip - DAY 1
(Note: PM on reverse side)

	FIRST NAME AND LAST INITIAL OF PEOPLE RIDING THIS MORNING	CHECK IF PICKED UP AT HOME	TIME	ODOMETER READING
AM PICK-UP	Driver	√	am	
	1		am	
	2		am	
	3		am	
	4		am	
	5		am	
	6		am	
	7		am	
	8		am	
	9		am	
	10		am	
	11		am	
	12		am	
	13		am	
A.M. DROP-OFF	Enter North Freeway		am	
	Enter CFL		am	
	Exit CFL		am	
	1st Dropoff		am	
	2nd Dropoff		am	
	3rd Dropoff		am	
	4th Dropoff		am	
	Park Van		am	

PLEASE COMPLETE FORM ON REVERSE SIDE THIS AFTERNOON.

PLEASE ANSWER THE FOLLOWING:

1. At what cross-street do you enter the North Freeway in the morning?

____

2. What was the weather for this morning's trip? (CIRCLE ONE)

Fair Fog Rain

3. Please list the number of people absent from the van this morning with each reason, if known. (ie., sick, vacation, business trip, needed car at work, not ready on time, etc.)

____

____

____

____

____

4. Please describe any unusual occurrence which may have affected this trip's time or mileage:

____

____

____

____

____

____

____

____

VANPOOL TRAVEL LOG

Day:__________ Date:____________

Afternoon trip - DAY 1

(Note: AM on reverse side)

	FIRST NAME AND LAST INITIAL OF PEOPLE RIDING THIS AFTERNOON		CHECK IF DROP-PED OFF AT HOME	TIME	ODOMETER READING
PM PICK-UP	Driver Gets Van			pm	
	1st Pickup			pm	
	2nd Pickup			pm	
	3rd Pickup			pm	
	4th Pickup			pm	
	Enter CFL			pm	
	Exit CFL			pm	
	Exit North Freeway			pm	
PM DROP-OFF	1			pm	
	2			pm	
	3			pm	
	4			pm	
	5			pm	
	6			pm	
	7			pm	
	8			pm	
	9			pm	
	10			pm	
	11			pm	
	12			pm	
	13			pm	
	Driver			pm	

PLEASE ANSWER THE FOLLOWING QUESTIONS:

1. Did you purchase gas today? ☐ YES ☐ NO

   If YES, ______________ odometer reading

   ______________ number of gallons purchased

2. At what cross-street do you exit the North Freeway in the afternoon?

   ____

3. What was the weather for this afternoon's trip? (CIRCLE ONE)

   Fair Fog Rain

4. Please list the number of people absent from the van this afternoon with each reason, if known.

   ____

   ____

   ____

   ____

5. If you used the van during the day, what was the purpose of the trip(s)?

   ____

   ____

6. Please describe any unusual occurrence which may have affected this trip's time or mileage.

   ____

   ____

   ____

   ____

VANPOOL TRAVEL LOG - DAYS 2-5 Day:__________ Date:___________

MORNING TRIP

AM PICK-UP

First name and last initial of people riding this morning	✓ if picked up at home	Time	Odometer Reading
Driver	✓	am	
1		am	
2		am	
3		am	
4		am	
5		am	
6		am	
7		am	
8		am	
9		am	
10		am	
11		am	
12		am	
13		am	
Enter North Freeway		am	
Enter CFL		am	
Exit CFL		am	
Arrive Work Area		am	
Park Van		am	

AFTERNOON TRIP

PM DROP-OFF

First name and last initial of people riding this afternoon	✓ if dropped off at home	Time	Odometer Reading
Driver gets van		pm	
Leave work area		pm	
Enter CFL		pm	
Exit CFL		pm	
Exit North Fwy.		pm	
1		pm	
2		pm	
3		pm	
4		pm	
5		pm	
6		pm	
7		pm	
8		pm	
9		pm	
10		pm	
11		pm	
12		pm	
13		pm	
Driver		pm	

1. If the morning odometer reading is higher than yesterday's last odometer reading, please describe the type of personal travel for which the van was used:
____

2. Please list the number of people absent from the van and indicate AM, PM or both, and the reasons for each absence, if known:
____
____

3. Please describe any unusual occurrence which may have affected the morning or afternoon vanpool time or mileage: ________________________
____

4. Weather in the morning (CIRCLE ONE) Fair Fog Rain

   Weather in the afternoon (CIRCLE ONE) Fair Fog Rain

5. Did you purchase gas today? ☐ YES ☐ NO If YES, Odometer reading: ______________

   Gallons purchased: ______________

To Drivers:

Texas Transportation Institute is conducting an evaluation of the North Freeway Contraflow Lane to determine its impacts on auto drivers. As a part of the evaluation, we request that you complete this questionnaire. Your responses will be of great value to the study and will be held in strict confidence.

Your vehicle was spotted at random between 6:30 and 9:00 AM during the past two weeks on the North Freeway by license plate observers, and your name and address were furnished by the State from their registration files. If you have not personally driven on the North Freeway in the past two weeks, please give these materials to the person who drove your car. If your car was never on the North Freeway during this time, please forgive our error and disregard this survey.

If on your last morning trip on the North Freeway you had passengers in your auto, please give one of the enclosed passenger questionnaires and one return envelope to each of your passengers.

Postage-paid envelopes have been enclosed for your convenience in returning these questionnaires. It is very important that you complete this questionnaire as soon as possible and mail it promptly. Thank you very much for your cooperation.

1. What was the primary purpose of your most recent weekday morning peak period (6:30-9 AM) trip on the North Freeway (that is, what did you do at your destination)?

   ____ work

   ____ social-recreational

   ____ shopping or dining

   ____ doctor/dentist

   ____ personal business

   ____ school

   ____ other (specify): ________________

2. What entrance and what exit did you use on the North Freeway for your most recent weekday morning peak period (6:30-9 AM) trip? (CHECK ONE IN EACH COLUMN.)

enter	exit	
____	____	1. North of N. Shepherd
____	____	2. N. Shepherd/Canino
____	____	3. Little York
____	____	4. Parker-Yale
____	____	5. Tidwell
____	____	6. Airline
____	____	7. Crosstimbers
____	____	8. I-610
____	____	9. Cavalcade
____	____	10. Patton
____	____	11. N. Main
____	____	12. I-10
____	____	13. Downtown or I-45 thru town

3. Did you use the North Freeway for your return trip that afternoon?

   ____ yes

   ____ no

   If yes, list the number of the entrance and the number of the exit (from Question 2) which you used for the afternoon trip.

   ________ PM North Freeway Entrance

   ________ PM North Freeway Exit

4. At what time did you enter the North Freeway in the morning and enter in the afternoon? (Please indicate the times to the nearest quarter hour; i.e., 7:00, 7:15, 7:30 or 7:45.)

   ________ AM ________ PM

5. How many people including yourself were in your auto on your most recent weekday morning peak period (6:30-9 AM) trip on the North Freeway?

   ________ people

   How many people including yourself were in your auto on the return trip that afternoon?

   ________ people

6. If there were others in your car for the morning trip, please indicate the number of passengers falling into each of these categories:

   ________ number of household members

   ________ number of passengers employed by same firm

   ________ both of the above

   ________ neither of the above

7. How did you "find" the other people with whom you ride? (CHECK AS MANY AS APPLY.)

___ I live with them

___ They live in my neighborhood

___ They work with me

___ My employer matched us

___ CarShare matched us

___ Another organization matched us

___ Other (specify): ___

8. What was your destination on your most recent weekday morning peak period (6:30-9 AM) trip on the North Freeway?

___ Downtown

___ Texas Medical Center

___ Post Oak/Galleria

___ Greenway Plaza

___ Other (specify ZIP code) ___

9. For your most recent morning peak period (6:30-9 AM) trip on the North Freeway, where was the auto parked?

___ Garage (Name: ___)

___ On the street

___ In a city-operated lot

___ In a private parking lot

___ Other (specify) ___

10. What did you personally pay for parking? (DO NOT INCLUDE ANY AMOUNT CONTRIBUTED OR REIMBURSED BY YOUR EMPLOYER OR PASSENGERS IN YOUR CAR.)

$ ___ Per day

OR $ ___ Per Month

11. How did you travel between your parking spot and work (or other activity)?

___ walk

___ bus: Route Name or No. ___

___ other (specify) ___

How many minutes did it take you to travel from your parking spot to work (or other activity)?

___ minutes

12. How many miles (one-way) did you travel from home to your final destination? Include any miles you may have travelled out of your way to pick up passenger(s).

___ miles one-way

If you were to drive by yourself directly from home to your final destination (work), how many miles (one-way) would you travel?

___ miles one-way

13. For your morning trip, how many minutes did you spend driving in your car (one-way)?

___ minutes one-way

If you were to drive by yourself directly from home to your final destination (work), how many minutes would it take?

___ minutes one-way

14. If you regularly travel to work on the North Freeway by auto, when did you begin travelling by the means you now usually use (either driving by yourself or driving with others)?

___ month ___ year

15. For each of the following travel means, please indicate which you could have used for your morning trip. (CHECK AS MANY AS APPLY.) For each available travel means, please estimate the number of minutes the trip would take.

✓ If Avail.	Minutes	
___	___	driven by household member
___	___	driven by someone not in my household
___	___	walking to and riding a bus
___	___	driving to and riding a bus
___	___	vanpool

16. If you usually drive alone for your morning peak period (6:30-9 AM) trip, what is the major reason you do not regularly carpool or vanpool? (CHECK ONLY ONE.)

___ I cannot find others with similar trips

___ I need my car during the day

___ Pooling is unreliable or undependable

___ I have an irregular schedule

___ I like the privacy or convenience of driving without others

___ Pooling takes too long

___ Other (specify) ___

17. Have you heard of METRO's CarShare program?

___ yes

___ no

___ If yes, from what source? ___

18. Did you ever contact CarShare for a carpool or vanpool match?

___ yes

___ no

19. What is the major reason you do not ride the bus for your morning peak period (6:30-9 AM) trips? (CHECK ONLY ONE.)

____ There is no appropriate service available

____ I need my car during the day

____ Service is unreliable or undependable

____ I have an irregular schedule

____ I like the privacy or convenience of driving

____ Riding the bus takes too long

____ Other (specify) ____________

20. On a scale of 1 to 5 where 1 means "extremely important," 3 means "neutral," and 5 means "not at all important," please rate the importance of each of the following factors in determining your travel means on the North Freeway: (CHECK ONE IN EACH ROW.)

Extremely Important	Important	Neutral	Unimportant	Extremely Unimportant	
___	___	___	___	___	save time
___	___	___	___	___	save money
___	___	___	___	___	save wear on auto
___	___	___	___	___	dislike driving
___	___	___	___	___	dependability
___	___	___	___	___	convenience
___	___	___	___	___	safety
___	___	___	___	___	flexibility to determine own travel schedule
___	___	___	___	___	privacy
___	___	___	___	___	option to make stops on the way to or home from work (or other activity)

21. Are you aware of the operation of the North Freeway Contraflow Lane in which buses and vans are permitted to travel in a reserved lane against the normal flow of traffic?

____ yes

____ no

22. How many minutes, if any, do you think vanpools and buses save in the morning on the North Freeway by using the Contraflow Lane instead of the regular freeway lanes?

________ minutes

23. Do you believe the Contraflow Lane has increased, decreased, or had no effect on: (CHECK ONE IN EACH ROW.)

Large increase	Some increase	No effect	Some decrease	Large decrease	Not sure	
___	___	___	___	___	___	The number of delays you experience on the freeway
___	___	___	___	___	___	Morning inbound and afternoon outbound freeway congestion
___	___	___	___	___	___	Morning outbound and afternoon inbound freeway congestion
___	___	___	___	___	___	Total number of people travelling on the North Freeway including those on the Contraflow Lane
___	___	___	___	___	___	Average freeway travel speeds of all people
___	___	___	___	___	___	Your operating costs on the freeway
___	___	___	___	___	___	Driver attentiveness (safer driving habits)
___	___	___	___	___	___	Traffic accidents (on the Contraflow side)
___	___	___	___	___	___	Traffic accidents (not on the Contraflow side)
___	___	___	___	___	___	Reducing fuel consumption
___	___	___	___	___	___	Air quality

24. What impact has the Contraflow Lane had on your travel time on the North Freeway in the morning?

___ increased by ____ minutes

___ decreased by ____ minutes

___ no effect

25. What impact has the Contraflow Lane had on your travel time on the North Freeway in the afternoon?

___ increased by ____ minutes

___ decreased by ____ minutes

___ no effect

26. Do you believe the following have increased, decreased, or had no effect on your travel time?

Large increase	Some increase	No effect	Some decrease	Large decrease	Not sure	
___	___	___	___	___	___	Ramp metering signals
___	___	___	___	___	___	Temporary ramp closures (barricades placed on selected entry ramps)

27. In your opinion, are there currently too few vehicles using the Contraflow Lane to justify the project?

___ yes

___ no

28. Which of the following would you favor or disfavor for increasing the number of people using the Contraflow Lane? (CHECK ONE IN EACH ROW.)

Strongly favor 1	Favor 2	Neutral 3	Disfavor 4	Strongly disfavor 5	Not Sure 6	
___	___	___	___	___	___	A. More marketing of existing bus service
___	___	___	___	___	___	B. More bus service on existing routes
___	___	___	___	___	___	C. Construction of more park-and-ride lots
___	___	___	___	___	___	D. Allow carpools on Contraflow Lane
___	___	___	___	___	___	E. Encourage more vanpooling

29. Which one of the above (from Question 28) do you think would be most important in increasing the number of people using the Contraflow Lane? (CIRCLE THE APPROPRIATE LETTER.)

A B C D E

30. What is your home ZIP Code?

____

31. How long have you lived at your current address?

_______ years _______ months

32. What is your occupation?

___ sales
___ executive
___ professional
___ shop-factory worker
___ clerical-office
___ craftsperson-foreman
___ service worker
___ student
___ homemaker
___ retired
___ unemployed
___ other

33. If you are employed, how long have you been with your current employer at your current location?

_______ years _______ months

34. What is your age?

___ less than 16
___ 16-25
___ 26-35
___ 36-45
___ 46-55
___ 56-64
___ 65 and older

35. Are you . . .?

___ male
___ female

36. How many vehicles (autos, vans, pick-up trucks or recreational vehicles--RVs) are owned by your household?

_____ vehicles

37. How many licensed drivers including yourself are there in your household?

_____ licensed drivers

38. Do you have use of a vehicle (auto, van, truck or RV) every day without inconvenience to other household members?

___ yes, I always have a vehicle available
___ no, I never or rarely have a vehicle available
___ no, using a vehicle every day would occasionally be inconvenient to family members

39. In what range is your annual combined household income? (Your response is strictly confidential.)

___ $ 0- 9,999
___ $10,000-14,999
___ $15,000-19,999
___ $20,000-24,999
___ $25,000-29,999
___ $30,000-39,999
___ $40,000-59,999
___ $60,000 or more

COMMENTS OR EXPLANATIONS: ____________

THANK YOU FOR YOUR COOPERATION.

To Passengers:

Texas Transportation Institute is conducting an evaluation of the North Freeway Contraflow Lane to determine its impacts on auto drivers and passengers. As a part of the evaluation, we request that you complete this questionnaire. Your responses will be of great value to the study and will be held in strict confidence.

A vehicle in which you were travelling was spotted at random between 6:30 and 9:00 AM during the past two weeks on the North Freeway by license plate observers, and the name and address of the owner were furnished by the State from their registration files. The owner of the vehicle was mailed a driver questionnaire, this passenger questionnaire, and postage-paid envelopes for your convenience in returning them.

Unless otherwise noted, please respond with information about the last morning trip you made as a passenger with the person who gave you this questionnaire. It is very important that this questionnaire be completed as soon as possible and mailed promptly. Thank you very much for your cooperation.

1. What was the primary purpose of your last morning trip as a passenger on the North Freeway (that is, what did you do at your destination)?

   ____ work
   ____ social-recreational
   ____ shopping or dining
   ____ doctor/dentist
   ____ personal business
   ____ school
   ____ other (specify): ____________

2. What entrance and what exit did you use on the North Freeway for this trip? (CHECK ONE IN EACH COLUMN.)

enter	exit	
____	____	1. North of N. Shepherd
____	____	2. N. Shepherd/Canino
____	____	3. Little York
____	____	4. Parker-Yale
____	____	5. Tidwell
____	____	6. Airline
____	____	7. Crosstimbers
____	____	8. I-610
____	____	9. Cavalcade
____	____	10. Patton
____	____	11. N. Main
____	____	12. I-10
____	____	13. Downtown or I-45 thru town

3. Did you use the North Freeway for your return trip that afternoon?

   ____ yes
   ____ no

   If yes, list the number of the entrance and the number of the exit (from Question 2) which you used for the afternoon trip.

   ____ PM North Freeway Entrance
   ____ PM North Freeway Exit

4. At what time did you enter the North Freeway in the morning and enter in the afternoon? (Please indicate the times to the nearest quarter hour; i.e., 7:00, 7:15, 7:30, 7:45.)

   ________ AM ________ PM

5. How many people including yourself were in the auto for the morning trip on the North Freeway?

   ________ people

   How many people including yourself were in the auto on the return trip that afternoon?

   ________ people

6. Please indicate the number of people travelling with you in the morning falling into each of these categories:

   ________ household member
   ________ employed by same firm
   ________ both of the above
   ________ neither of the above

7. How did you "find" the other people with whom you ride? (CHECK AS MANY AS APPLY)

___ I live with them.

___ They live in my neighborhood.

___ They work with me.

___ My employer matched us.

___ CarShare matched us.

___ Another organization matched us.

___ Other (specify) ____________

8. What was your destination for the morning trip on the North Freeway?

___ Downtown

___ Texas Medical Center

___ Post Oak/Galleria

___ Greenway Plaza

___ Other (specify ZIP code) ____________

9. How many miles (one-way) did you travel from home to your final destination. Include any miles you may have travelled out of your way while others were picked up. (If you are not sure, please check with the driver or give your best estimate.)

_______ miles one-way

10. For your morning trip, how many minutes did you spend riding in the car (one-way)?

_______ minutes one-way

How many minutes did it take you to travel from where you were dropped off to your final destination (work)?

_______ minutes

11. If you were to drive by yourself from home to the destination indicated in #8, how many miles would the trip be?

_______ miles one-way

How many minutes would it take?

_______ minutes one-way

12. If you regularly travel to work on the North Freeway by auto, when did you begin travelling by the means you now usually use (either riding with someone or sharing the driving in a carpool)?

_______ month _______ year

13. If you formerly made this trip by a means other than how you currently travel, please indicate how:

___ Always made this trip as a passenger

___ Always made this trip by sharing the driving in a carpool

___ Drove without passengers

___ Bus; Route name and number ____________

___ Vanpool

___ Motorcycle, bicycle, taxi, other

14. For each of the following travel means, please indicate which you could have used for your morning trip. (CHECK AS MANY AS APPLY.) For each available travel means, please estimate the number of minutes the trip would take.

✓ If Avail.	Minutes	
____	____	driving myself without passengers
____	____	walking to and riding a bus
____	____	driving to and riding a bus
____	____	vanpool

15. If you are usually an auto passenger or share driving for your morning peak period (6:30-9 AM) trip, what is the major reason you do not vanpool? (CHECK ONLY ONE.)

___ There is no vanpool going from the vicinity of my home to my office.

___ I often need a car during the day

___ I cannot meet the same schedule every day.

___ Vanpooling is too expensive

___ Vanpooling takes too long

___ Other (specify) ____________

16. What is the major reason you do not ride the bus for your morning peak period (6:30-9 AM) trips? (CHECK ONLY ONE.)

___ There is no appropriate service available

___ I often need a car during the day

___ Service is unreliable or undependable

___ I have an irregular schedule

___ Riding the bus takes too long

___ Other (specify) ____________

17. On a scale of 1 to 5 where 1 means "extremely important," 3 means "neutral," and 5 means "not at all important," please rate the importance of each of the following factors in determining your travel means on the North Freeway. (CHECK ONE IN EACH ROW.)

Extremely important 1	Somewhat important 2	Neutral 3	Somewhat unimportant 4	extremely unimportant 5	
___	___	___	___	___	save time
___	___	___	___	___	save money
___	___	___	___	___	save wear on auto
___	___	___	___	___	dislike driving
___	___	___	___	___	dependability
___	___	___	___	___	convenience
___	___	___	___	___	safety
___	___	___	___	___	flexibility to determine own travel schedule
___	___	___	___	___	privacy
___	___	___	___	___	option to make stops on the way to or home from work (or other activity)

18. Are you aware of the operation of the North Freeway Contraflow Lane in which buses and vans are permitted to travel in a reserved lane against the normal flow of traffic?

___ yes

___ no

19. Do you believe the Contraflow Lane has increased, decreased, or had no effect on: (CHECK ONE IN EACH ROW.)

Large increase 1	Some increase 2	No effect 3	Some decrease 4	Large decrease 5	Not sure 6	
___	___	___	___	___	___	the number of delays you experience on the freeway
___	___	___	___	___	___	Morning inbound and afternoon outbound freeway congestion
___	___	___	___	___	___	Morning outbound and afternoon inbound freeway congestion

20. How many minutes, if any, do you think vanpools and buses save in the morning on the North Freeway by using the Contraflow Lane instead of the regular freeway lanes?

________ minutes

21. What impact has the Contraflow Lane had on your travel time on the North Freeway in the <u>morning</u>?

___ increased by ________ minutes

___ decreased by ________ minutes

___ no effect

22. What impact has the Contraflow Lane had on your travel time on the North Freeway in the <u>afternoon</u>?

___ increased by ________ minutes

___ decreased by ________ minutes

___ no effect

23. In your opinion, are there currently too few vehicles using the Contraflow Lane to justify the project?

___ yes

___ no

24. Which of the following would you favor or disfavor for increasing the number of people using the Contraflow Lane? (CHECK ONE IN EACH ROW.)

Strongly favor	Favor	Neutral	Disfavor	Strongly disfavor	Not sure	
___	___	___	___	___	___	A. More marketing of existing bus service
___	___	___	___	___	___	B. More bus service on existing routes
___	___	___	___	___	___	C. Construction of more park-and-ride lots
___	___	___	___	___	___	D. Allow carpools on Contraflow Lane
___	___	___	___	___	___	E. Encourage more vanpooling

25. Which <u>one</u> of the above (from Question 24) do you think would be <u>most important</u> in increasing the number of people using the Contraflow Lane? (CIRCLE THE APPROPRIATE LETTER.)

A B C D E

26. What is your home ZIP Code?

____

27. How long have you lived at your current address?

________ years ________ months

28. What is your occupation?

___ sales ___ service worker

___ executive ___ student

___ professional ___ homemaker

___ shop-factory worker ___ retired

___ clerical-office ___ unemployed

___ craftsperson-foreman ___ other ________

29. If you are employed, how long have you been with your current employer at your current location?

____ years ____ months

30. What is your age?

____ less than 16	____ 46-55
____ 16-25	____ 56-64
____ 26-35	____ 65 and older
____ 36-45	

31. Are you . . .?

____ male

____ female

32. How many vehicles (autos, vans, pick-up trucks or recreational vehicles--RVs) are owned by your household?

____ vehicles

33. Are you a licensed driver?

____ yes

____ no

34. How many licensed drivers (including yourself) are there in your household?

____ licensed drivers

33. Do you have use of a vehicle (auto, van, truck or RV) every day without inconvenience to other household members?

____ yes, I always have a vehicle available

____ no, I never or rarely have a vehicle available

____ no, using a vehicle every day would occasionally be inconvenient to family members

34. In what range is your annual combined household income? (Your response is strictly confidential)

____ $ 0- 9,999

____ $10,000-14,999

____ $15,000-19,999

____ $20,000-24,999

____ $25,000-29,999

____ $30,000-39,999

____ $40,000-59,999

____ $60,000 or more

COMMENTS OR EXPLANATIONS:

THANK YOU FOR YOUR COOPERATION.

Texas Transportation Institute is conducting an evaluation of the North Freeway Contraflow Lane to determine its impacts on auto drivers. As a part of the evaluation, we request that you complete this questionnaire. Your responses will be of great value to the study and will be held in strict confidence.

Your vehicle was spotted at random between 6:30 and 9:00 AM during the past two weeks on the North Freeway by license plate observers, and your name and address were furnished by the State from their registration files. If you have not personally driven on the North Freeway in the past two weeks, please give this questionnaire to the person who drove your car. If your car was never on the North Freeway during this time, please forgive our error and disregard this survey.

A postage-paid envelope has been enclosed for your convenience in returning this questionnaire. It is very important that you complete this questionnaire as soon as possible and mail it promptly. Thank you very much for your cooperation.

1. What was the primary purpose of your most recent weekday morning peak period (6:30-9 AM) trip on the North Freeway (that is, what did you do at your destination)?

   ____ work
   ____ social-recreational
   ____ shopping or dining
   ____ doctor/dentist
   ____ personal business
   ____ school
   ____ return home
   ____ other (specify): ____________

2. How many people (including yourself) were in your auto on your most recent weekday morning peak period (6:30-9 AM) trip on the North Freeway?

   ________ people

3. Did you use the North Freeway for your return trip that afternoon?

   ____ yes
   ____ no

   If yes, how many people (including yourself) were there in your auto for this afternoon trip?

   ________ people

4. What is the ZIP code of your destination?

   ____________ morning destination ____________ afternoon destination

5. What entrance and what exit did you use on the North Freeway for your most recent weekday morning peak period (6:30-9 AM) trip? (CHECK ONE IN EACH COLUMN.)

am enter	exit	
____	____	1. North of N. Shepherd
____	____	2. N. Shepherd/Canino
____	____	3. Little York
____	____	4. Parker-Yale
____	____	5. Tidwell
____	____	6. Airline
____	____	7. Crosstimbers
____	____	8. I-610
____	____	9. Cavalcade
____	____	10. Patton
____	____	11. N. Main
____	____	12. I-10
____	____	13. Downtown or I-45 thru town

6. If you used the North Freeway for your return trip that afternoon, list the number of the entrance and the number of the exit (from question #5) which you used.

   ________ Afternoon North Freeway entrance
   ________ Afternoon North Freeway exit

7. For your most recent weekday peak period trip, at what time did you enter the North Freeway in the morning and enter in the afternoon? (Please indicate the times to the nearest quarter hour; i.e., 7:00, 7:15, 7:30, 7:45.)

   ________ AM ________ PM

8. Are you aware of the operation of the North Freeway Contraflow Lane in which buses and vans are permitted to travel in a reserved lane against the normal flow of traffic?

___ yes

___ no

9. Did you use different entrances or exits for the trip you described above before the Contraflow Lane opened?

___ no, my route on the freeway is the same

___ yes, in the morning only

___ yes, in the afternoon only

___ yes, in the morning and the afternoon

___ I did not make this trip on the North Freeway before the Contraflow Lane opened

10. In the past, have you changed your route on the freeway temporarily because of the Contraflow Lane?

___ Yes, starting when Contraflow first opened (September 1979)

___ Yes, starting after Contraflow had been operating for several months

___ No, my route on the freeway is the same

___ I did not usually drive on the North Freeway before Contraflow operation began

11. If yes, what was your temporary route?

___ different entrances or exits on the North Freeway

___ North Freeway Frontage Road only

___ Northwest Freeway

___ Eastex Freeway

___ City Streets (specify major street used)

12. If you are a regular morning traveller on the North Freeway, have you changed the time you begin your morning trip since the Contraflow Lane opened?

___ yes, it is now ___ minutes earlier

___ yes, it is now ___ minutes later

___ no

___ I did not make this trip by auto before the Contraflow Lane opened.

13. If you are a regular afternoon traveller on the North Freeway, have you changed the time you begin your afternoon trip since the Contraflow Lane opened?

___ yes, it is now ___ minutes earlier

___ yes, it is now ___ minutes later

___ no

___ I did not make this trip by auto before the Contraflow Lane opened.

14. How many miles did you travel (one-way) from your home to your morning destination? Include any miles you may have travelled out of your way to pick up passenger(s).

___ miles one-way

If you were to drive by yourself directly from home to your final destination (work), how many one-way miles would you travel?

___ miles one-way

15. For your morning trip, how many minutes did you spend driving in your car (one-way)?

___ minutes one-way

If you were to drive by yourself directly from home to your final destination (work), how many minutes would it take?

___ minutes one-way

16. How many minutes did it take you to travel from your parking spot to your final destination (work)?

___ minutes

17. If you regularly travel on the North Freeway by auto in the morning peak period (6:30-9 AM), when did you begin travelling by the means you now usually use (either driving by yourself or driving with others)?

___ month ___ year

18. If you usually drive alone, what is the major reason you do not regularly carpool? (CHECK ONLY ONE.)

___ I cannot find others with similar trips

___ I need my car during the day

___ Pooling is unreliable or undependable

___ I have an irregular schedule

___ I like the privacy or convenience of driving without others

___ Pooling takes too long

___ Other (specify): ___

19. Do you believe the Contraflow Lane has increased, decreased, or had no effect on: (CHECK ONE IN EACH ROW.)

Large increase	Some increase	No effect	Some decrease	Large decrease	Not sure	
___	___	___	___	___	___	The number of delays you experience on the freeway
___	___	___	___	___	___	Morning inbound and afternoon outbound freeway congestion
___	___	___	___	___	___	Morning outbound and afternoon inbound freeway congestion
___	___	___	___	___	___	Total number of people travelling on the North Freeway including those on the Contraflow Lane
___	___	___	___	___	___	Average freeway travel speeds of all people
___	___	___	___	___	___	Your operating costs on the freeway
___	___	___	___	___	___	Driver attentiveness (safer driving habits)
___	___	___	___	___	___	Traffic accidents (on the Contraflow side)
___	___	___	___	___	___	Traffic accidents (<u>not</u> on the Contraflow side)
___	___	___	___	___	___	Reducing fuel consumption
___	___	___	___	___	___	Air quality

20. What impact has the Contraflow Lane had on your travel time on the North Freeway in the <u>morning</u>?

___ increased by _______ minutes

___ decreased by _______ minutes

___ no effect

21. What impact has the Contraflow Lane had on your travel time on the North Freeway in the <u>afternoon</u>?

___ increased by _______ minutes

___ decreased by _______ minutes

___ no effect

22. Do you believe the following have increased, decreased, or had no effect on your travel time?

Large increase	Some increase	No effect	Some decrease	Large decrease	Not sure	
___	___	___	___	___	___	Ramp metering signals
___	___	___	___	___	___	Temporary ramp closures (barricades placed on selected entry ramps)

23. In your opinion, are there currently too few vehicles using the Contraflow Lane to justify the project?

___ yes

___ no

24. Which of the following would you favor or disfavor for increasing the number of people using the Contraflow Lane? (CHECK ONE IN EACH ROW.)

Strongly favor	Favor	Neutral	Disfavor	Strongly disfavor	Not sure	
___	___	___	___	___	___	A. More marketing of existing bus service
___	___	___	___	___	___	B. More bus service on existing routes
___	___	___	___	___	___	C. Construction of more park-and-ride lots
___	___	___	___	___	___	D. Allow carpools on Contraflow Lane
___	___	___	___	___	___	E. Encourage more vanpooling

25. Which <u>one</u> of the above (from Question 25) do you think would be <u>most important</u> in increasing the number of people using the Contraflow Lane? (CIRCLE THE APPROPRIATE LETTER.)

A B C D E

26. Do you believe that travelling in a car in the lanes next to contraflow vans and buses is more safe, less safe, or no different than travelling in a car on the freeway with no contraflow operation?

___ Contraflow makes car travel safer

___ There is no difference

___ Contraflow makes car travel less safe

___ Not sure

27. Which of the following help you determine when the Contraflow Lane is operating?

Extremely important	Important	Neutral	Unimportant	Extremely unimportant	
___	___	___	___	___	Flashing yellow lights in the median
___	___	___	___	___	Yellow posts placed into pavement
___	___	___	___	___	Overhead lane signals (red "X" and green "⇩")
___	___	___	___	___	Changeable message signs at approaches to the Contraflow Lane
___	___	___	___	___	Vehicles travelling in the Contraflow Lane

28. What is your home ZIP Code?

____

29. How long have you lived at your current address?

_______ years _________ months

30. What is your occupation?

- ___ sales
- ___ executive
- ___ professional
- ___ shop-factory worker
- ___ clerical-office
- ___ craftsperson-foreman
- ___ service worker
- ___ student
- ___ homemaker
- ___ retired
- ___ unemployed
- ___ other _________

31. If you are employed, how long have you been with your current employer at your current location?

_______ years _________ months

32. What is your age?

- ___ less than 16
- ___ 16-25
- ___ 26-35
- ___ 36-45
- ___ 46-55
- ___ 56-64
- ___ 65 and older

33. Are you . . .?

- ___ male
- ___ female

34. In what range is your annual combined household income? (Your response is strictly confidential.)

- ___ $ 0- 9,999
- ___ $10,000-14,999
- ___ $15,000-19,999
- ___ $20,000-24,999
- ___ $25,000-29,999
- ___ $30,000-39,999
- ___ $40,000-59,999
- ___ $60,000 or more

COMMENTS OR EXPLANATIONS:

____

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THANK YOU VERY MUCH FOR YOUR COOPERATION.

APPENDIX B: CONTRAFLOW DRIVER TRAINING MANUAL

DRIVER MANUAL

METRO

Metropolitan Transit Authority of Harris County

OPERATING INSTRUCTIONS
NORTH FREEWAY CONTRAFLOW LANE

The nation's longest Contraflow Lane operates along I-45 North Freeway in Houston, Texas. The 9.6-mile project, a joint effort of the Metropolitan Transit Authority and the Texas Department of Highways and Public Transportation, extends from the northern edge of the central business district to the interchange of North Freeway at Stuebner-Airline/Shepherd Drives.

The Contraflow concept is an innovative approach to providing priority treatment for transit vehicles during rush hour. Contraflow "borrows" an existing freeway lane from the less congested side of the freeway and allows authorized transit vehicles to travel that lane in the opposite direction of the non-rush hour traffic, or "contraflow". Thus, additional freeway capacity for rush hour traffic is added.

The distinct rush hour traffic split on the North Freeway lends itself to the Contraflow concept of "borrowing" a lane from the less congested non-peak direction of traffic to use for commuter transit.

Contraflow projects have been operating in major metropolitan areas since the early 1970's. Currently, Contraflow operates in New York City on the approach to the Lincoln Tunnel and at the entrance to the Golden Gate Bridge in San Francisco.

However, Houston's North Freeway Contraflow has several features which make it unique among similar projects in the country:

* Houston's 9.6-mile Lane is the longest in the United States.
* Houston's Contraflow is the only one to operate in both morning and afternoon rush hours.
* Houston's Contraflow Lane is the only one in the country to provide mid-point entrance and exit capability.

Several new METRO routes are planned to operate via Contraflow to provide convenient commuter alternatives to residents in North Harris County.

In addition to express transit service downtown, passengers may ride via Contraflow through downtown to Greenway Plaza and Post Oak/Galleria---the first such service from north Houston.

HOW CONTRAFLOW WORKS

During morning rush hours, the inside lane on the northbound side of the freeway is used for Contraflow---allowing authorized transit vehicles to travel inbound toward downtown.

In the afternoon, the operation is reversed. The inside lane of the southbound side of the North Freeway is used for Contraflow---allowing authorized transit vehicles to travel outbound away from downtown.

CONTRAFLOW HOURS OF OPERATION

The Contraflow Lane Hours of Operation shall mean the time period when authorized vehicles shall be allowed to use the Lane. The Lane is currently in operation for the following time periods

6:00 - 8:30 AM

4:00 - 6:30 PM

However, portions of the Contraflow Lane will be restricted and occupied by the Contraflow Operation Crews during the following time periods:

Set-up	Take-down
4:30 - 6:00 AM	8:30 - 9:30 AM
2:30 - 4:00 PM	6:30 - 7:30 PM

The time periods will be in effect weekdays (Mondays through Fridays), with the exception of holidays recognized by METRO. Those holidays will generally be January 1, official U. S. Memorial Day, July 4, official U. S. Labor Day, Thanksgiving Day and December 25.

The Contraflow Lane may also be closed during periods of suspended operations. Suspension of operations may occur at any time due to severe weather or hazardous roadway conditions. When practical, notice of continued suspension of operation will appear in daily newspapers 24 hours in advance of such occurences.

Bright yellow safety posts are placed in pre-drilled holes along the freeway to separate the Contraflow Lane from other traffic lanes. The durable 18-inch posts are set 20 to 40 feet apart and bend upon impact to lessen the likelihood of them being struck or removed once they are positioned.

Special Contraflow Operations Crews begin the set-up procedure each morning and afternoon before the Lane is opened to authorized vehicles. The crews place the safety posts, turn on all appropriate signals, and open the specially-constructed gates to the Contraflow entrance and exit ramps. The set-up procedure begins each morning and afternoon about 90 minutes before the Lane is opened to authorized vehicles.

The take-down procedure begins immediately following rush hour each morning and afternoon with the crews carrying out the reverse operation of the set-up process---removing the safety posts, turning off the signals, and closing the entrance and exit gates. The take-down procedures take about one hour to complete each morning and evening after the Contraflow Lane is closed to authorized vehicles.

AUTHORIZATION REQUIREMENTS

REQUIREMENTS FOR VEHICLE AUTHORIZATION

Because of the special purpose of the Contraflow Lane, only authorized transit vehicles and professional drivers who have participated in the METRO Contraflow Driver Training course will be allowed on the Lane. To ensure that the most people will benefit from the Contraflow Lane, only high-occupancy vehicles like buses and vanpools will be considered for authorization.

1. All official METRO transit vehicles are eligible for Contraflow.

The following types of transit vehicles are eligible to be considered for Contraflow if all other METRO requirements for vehicle authorization are met.

2. A suburban commuter bus being operated under contract to METRO to provide transit services.

3. Other full-size transit vehicles being operated on regularly scheduled bus services and approved by METRO pursuant to the requirements set out below.

4. Other motor vehicles designed to carry 12 or more passengers including the driver, and approved by METRO pursuant to the requirements set out below.

The following additional requirements must be met before vehicles other than METRO vehicles, can be authorized to use the Contraflow Lane.

1. If a van designed to carry 12 or more passengers is proposed for Contraflow, a minimum of eight passengers, including the driver, must be registered to vanpool at the time of authorization. These passengers must continue to ride in the vanpool unless a substitution is found. The driver is required to keep a monthly log of the pool's ridership and METRO retains the right to conduct unannounced inspection of the vanpool records. Scheduled bus services are not subject to periodic passenger inspection stops.

2. Each vehicle and driver must maintain minimum insurance requirements in the following amounts:

   Automobile Liability Insurance with

   * not less than $250,000 coverage per Person for Bodily Injury

   * not less than $500,000 coverage per Occurrence for Bodily Injury

   * not less than $100,000 coverage for Property Damage.

3. For each vehicle and driver, METRO must be provided with a current, valid copy of the insurance policy, or a valid certificate of insurance from the insurance company. If a company or individual is self-insured, METRO must be provided a self-insurance certificate from each company or independent driver and evidence of (a) cash or investment reserves and (b) the ability to pay liability claims in the amounts specified.

4. A valid State of Texas inspection sticker must be displayed according to the State regulation.

5. Each vehicle must display a METRO issued Contraflow authorization decal on (a) the upper right hand corner of the front windshield, and (b) the lower right corner of the back window.

6. An authorized vehicle must be driven by a certified Contraflow driver at all times when operating on the Contraflow Lane.

REQUIREMENTS FOR DRIVER CERTIFICATION

To be certified to drive an authorized vehicle on the Contraflow Lane, every driver (including substitute and back-up drivers):

1. Must have a State of Texas Chauffers License.

2. Must have no more than two moving violations within the prior 1-year period (moving violation records will be checked), and be in good physical condition. METRO reserves the right to request a physical examination of a driver to determine fitness for driving.

3. Must complete the METRO Contraflow Driver Training Course.

4. Must maintain in the driver's possession the Contraflow driver identification card.

5. Must abide by the Rules and Regulations of the Contraflow Lane as presented in the Contraflow Driver Training course and changes thereto as updated by letter.

6. Must assume responsibility for the breakdown of the vehicle, which will include the responsibility incurred in removing the vehicle to a place of safety.

DRIVING THE CONTRAFLOW LANE

During morning rush hour, the Contraflow Lane operates southbound on the northbound side of the freeway.

In the evening, the lane operates northbound on the southbound side of the freeway.

SPECIAL SIGNS AND SIGNALS

Several features are used to separate the Lane from normal traffic:

1) Separate entry ramps have been constructed which allow vehicles to safely enter the Lane.

2) The Lane is separated from normal traffic flow by yellow safety posts placed in pre-drilled holes.

3) Special signs and signals have been installed along the freeway to alert motorists of oncoming vehicles.

METRO's Contraflow Lane also includes a special lane created from the freeway shoulder and an exclusive lane constructed especially to express Contraflow vehicles from I-45 under the I-10 Interchange into downtown.

Two types of signs alert motorists that the Lane is in use. Black and white signs with the diamond symbol indicate that the left lane is closed due to oncoming vehicles when the amber light is on.

Changeable message signs near the north terminal of the Contraflow Lane also indicate the Lane is closed due to oncoming vehicles. Signals along the Lane also indicate when the Lane is in use.

1) Green arrows show Lanes are open to normal use.

2) When the Lane is being converted for Contraflow operation, an amber "X" signals motorists the lane should not be used.

3) Finally when the Lane is in use by Contraflow, a red "X" warns other motorists not to use the Lane.

MORNING CONTRAFLOW OPERATION

During morning rush hour, your journey inbound on METRO's North Freeway

Contraflow Lane begins where I-45 North crosses North Shepherd and Stuebner-Airline. You may start traveling in the Contraflow Lane from one of two entrances.

1) To begin on Contraflow from the Shepherd/Stuebner-Airline Intersection, travel east to Shepherd, past the light, and under the freeway onto the ramp which normally takes traffic northbound onto the freeway. However, you must slow down and make a sharp right hand turn through the gate and onto the Contraflow Lane. After you enter the Lane, watch for vehicles merging from your right onto the Lane.

2) To enter the Contraflow Lane if you were already traveling southbound in normal traffic, approach the Contraflow entrance from the left lane just past Shepherd. To enter, merge left through the special ramp across the median into the Contraflow Lane.

Be sure to yield to other Contraflow vehicles that have already entered the Lane from the buttonhook ramp at Shepherd.

*WHEN ENTERING CONTRAFLOW, VEHICLES ON THE LEFT HAVE RIGHT-OF-WAY.

Now that you are on the Contraflow Lane, travel at a safe speed at least 200 feet behind the vehicle in front of you.

Continue on the Contraflow Lane until you reach the mid-point crossover at Loop 610. Under normal circumstances, simply proceed on the Contraflow past the mid-point crossover to continue into downtown.

When you approach the point where the freeway divides - near White Oak Bayou - slow down and prepare to enter the "reversible shoulder lane".

Cross the median onto the shoulder lane and drive cautiously since you will soon exit the shoulder lane and enter the exclusive transit lane leading to downtown.

To enter the separate transit lane, turn left through the gate. As you approach the end of the transit lane, prepare to turn right onto Louisiana to proceed toward downtown. On Louisiana you will again be traveling Contraflow until you reach the crossover to Smith Street. Cross right past the median.

You will now be in the left lane of Smith Street traveling with the normal traffic. After the intersection of Smith and Franklin, you can resume your journey with normal traffic flow.

AFTERNOON CONTRAFLOW OPERATION

Your journey outbound will basically be reverse of your inbound trip with several key exceptions:

1) You will enter the Contraflow project directly from Louisiana.

2) To get from the shoulder lane to the Contraflow Lane, you do not cross the median. You simply stay left to enter the Contraflow Lane.

3) At the intersection of I-45 North and Shepherd, you will use a different ramp to exit.

The outbound journey begins in the Contraflow Lane on Louisiana Street. The left lane is restricted to "authorized vehicles only" in the afternoon.

Stay in the left lane in order to turn left onto the special transitway. Turn left through the gate into the transit lane.

At the end of the transitway, turn right onto the shoulder. At the end of the shoulder lane, follow the yellow safety posts on your left and you will automatically continue onto the Contraflow Lane.

Continue traveling Contraflow past the mid-point crossover. As you approach the North Shepherd intersection prepare to exit the Contraflow Lane.

All Contraflow vehicles will use the same exit ramp at the north end of the Contraflow Lane. However, if you wish to return to Shepherd/Stuebner-Airline, make a sharp right, turn onto the buttonhook ramp which leads under the freeway.

If you wish to travel north of Shepherd, use the exit ramp to merge right onto the freeway.

As you approach the intersection of I-45 and North Shepherd, slow your speed and prepare to exit right onto the ramp.

To exit Shepherd/Stuebner-Airline, turn right and loop under the freeway. Then proceed into normal traffic on Stuebner-Airline.

To exit onto the northbound side of I-45 North, continue on the ramp and carefully merge right into normal traffic flow.

*WHEN YOU EXIT CONTRAFLOW VEHICLES ON THE RIGHT HAVE THE RIGHT-OF-WAY.

If you wish to continue on I-45 North, travel straight on the ramp. This allows you to merge right into normal traffic. Remember to yield to vehicles on your right.

GENERAL RULES OF OPERATION ON THE LANE

AUTHORIZED DRIVERS

Because of the sophisticated features of the Contraflow project and to ensure the express nature of the lane, only vehicles authorized by METRO will be allowed on the Lane. The drivers of these vehicles must have completed METRO's Contraflow Driver Training Course.

NORMAL OPERATION

Let's review the rules of normal operation on the Contraflow Lane:

1) Turn your headlights on before entering the Contraflow Lane.
2) Drive at a safe speed, normally between 25 and 45 miles per hour except in adverse conditions.
3) Maintain a distance of 200 feet between vehicles.
4) Yield right-of-way. When you enter Contraflow, vehicles on the left have the right-of-way. When you exit, vehicles on the right have the right-of-way.

COOPERATE WITH POLICE AND METRO SUPERVISORS

During operating hours, the Contraflow Lane is patrolled by Houston Police Officers and METRO Street Supervisors. They monitor traffic flow on the Lane and handle any situations that might arise which hinder smooth and efficient Contraflow operation.

Failure to cooperate with the Police or METRO personnel in the use of the Contraflow project may result in the revocation of authorization to use the Contraflow Lane.

APPROACHING A DISABLED VEHICLE

If you are driving on the lane and you see that the lane is blocked by a slowed or disabled vehicle in front of you...

* stop at least 200 feet behind the disabled vehicle.
* do not attempt to pass until the disabled vehicle is safely on the shoulder.
* <u>never</u> pass a disabled vehicle using the shoulder or non-contraflow lane unless directed by the Police.

If the driver of the disabled vehicle signals you to assist him in the transfer of passengers, pull alongside and slightly in front of the stalled vehicle for the orderly transfer of passengers.

After transferring the passengers, carefully proceed in the Contraflow Lane and resume your journey.

For obvious reasons, this maneuver should be performed under police supervision.

If the vehicle cannot maneuver to the shoulder, wait until a police officer and a wrecker can safely maneuver the vehicle out of your way.

IF YOUR VEHICLE BECOMES DISABLED

If <u>your</u> vehicles becomes disabled, make every attempt to continue your journey and exit the Contraflow Lane.

If you cannot exit the Contraflow Lane and you must stop, turn on your hazard lights, maneuver onto the shoulder leaving room to open the door and discharge passengers.

Keep your passengers in the vehicle. Place safety markers behind your vehicle to further warn other drivers. Flag down other drivers, as appropriate, to arrange for the orderly transfer of your passengers.

Again, when possible, wait for a police officer to supervise this maneuver.

FIRE EMERGENCY

In case of a fire emergency on your vehicle, get your vehicle to the shoulder.

Turn on your hazard lights, and direct your passengers to exit and move ahead of your vehicle as safely and rapidly as possible. Then place your safety markers behind your vehicle .

IF THE CONTRAFLOW LANE IS CLOSED

If for some reason the lane is blocked, the police or METRO personnel will attempt to notify you and prevent you from entering the Lane by closing the gates to the Contraflow Lane.

IF YOU MUST USE MID-POINT CROSSOVER AT LOOP 610 TO EXIT THE CONTRAFLOW LANE

If you are already on the Lane and it becomes blocked, you may be directed to exit via the mid-point crossover located on I-45 at Loop 610. To exit the mid-point crossover, merge right into the separated crossover lane and then merge right again into normal traffic flow.

Remember, the vehicle on your right will have the right-of-way.

Also note that the mid-point crossover does not allow you to exit to Loop 610. However, the mid-point crossover is designed to allow approved vehicles to enter the Lane by making certain carefully controlled maneuvers.

Should you need to use the mid-point crossover, remember that vehicles entering must yield to those vehicles on the left, and vehicles exiting, yield to those on the right.

* * * *

Courtesy, caution and care should be your watch words in using the Contraflow Lane.

Think in terms of providing the best possible service to your passengers. Drive courteously and adhere to all the rules and regulations of the Lane.

If asked to stop by METRO Supervisors or Houston Police, do so. The enforcement team is simply trying to insure that the Lane is operated efficiently and safely.

Take heed to all warning signals, signs, and markers along the Lane. They are there to insure the safety of you, your passengers, and all motorists along the North Freeway.

Finally, use good, sound judgement in dealing with emergencies on the Contraflow Lane. Make sure you provide aid to your passengers, remain calm, and follow instructions from Police Officers or METRO Supervisors that assist you.

CONTRAFLOW RULES AND REGULATIONS

RULES

1) No vehicle is allowed to enter the Contraflow Lane until it has met the criteria established by METRO for Authorized Vehicles. The vehicle can only be operated by a METRO Certified Contraflow Driver. The vehicle must display a METRO Contraflow authorized decal on the upper right hand corner of the front windshield, and on the lower right corner of the back window.

2) When merging into the Contraflow Lane, the vehicle on the left always has the right-of-way. When exiting from the Contraflow Lane, the vehicle to the right always has the right-of-way.

3) Vehicle headlights must be turned on before entering the Contraflow Lane. A safe driving speed should be adhered to at all times. Never exceed a maximum speed of 45 miles per hour. A minimum speed of 25 miles per hour must be adhered to unless operating under adverse conditions.

4) Maintain a minimum distance of 200 feet between vehicles.

5) NEVER pass a disabled vehicle by pulling out of the Contraflow Lane into a normal traffic lane, unless specifically instructed by a Police Officer. Do not attempt to use the freeway shoulder to pass a disabled vehicle unless directed by the Police.

6) If a vehicle develops some mechanical difficulties while using the Contraflow Lane, it is the responsibility of the driver to make his best effort to continue the journey in order to get off the Contraflow Lane before stopping. However, if a vehicle becomes disabled it is the responsibility of the driver to turn on vehicle hazard lights and maneuver the disabled vehicle onto the safety shoulder to free the Contraflow Lane for other vehicles.

   Vehicle drivers must always remember to allow room next to the median barrier to open the door to discharge passengers.

   The driver must keep all passengers in the disabled vehicle until an orderly transfer can be arranged. Whenever possible, wait for a Police officer to supervise the transfer of passengers.

7) If a disabled vehicle is able to move off the Contraflow moving Lane onto the shoulder and provide adequate room to pass, another vehicle may pass the disabled vehicle. This passing maneuver should be performed under the supervision of a Police Officer. However, the best judgement of the driver may be used when appropriate.

8) If sufficient room is available to pass the disabled vehicle, stop at least 200 feet behind the vehicle to prepare for the passing maneuver. If the driver of the disabled vehicle signals you to assist in the transfer of passengers, pull alongside and slightly in front of the stalled vehicle for the orderly transfer of passengers. After transferring the passengers, carefully proceed in the Contraflow Lane and resume your journey. For obvious reasons, this maneuver should be performed under Police supervision whenever possible. If Police protection is not available, the driver of the disabled vehicle is responsible for a safe and orderly transfer.

9) If sufficient room does not exist for a vehicle to safely pass a disabled vehicle in the Contraflow moving Lane DO NOT ATTEMPT THIS MANEUVER! A Police Officer and wrecker service will respond to the situation in a short period of time. It is important to remember that if you cannot pass a disabled vehicle, you must stop a minimum of 200 feet behind the vehicle and wait for a wrecker to move the disabled vehicle to an emergency shoulder. Prepare to receive passengers from the disabled vehicle under supervision of the Police.

10) All drivers must respect and respond to the direction of the City of Houston Police and representatives of the Metropolitan Transit Authority whenever special direction is given for operation of the Contraflow Lane. Failure to cooperate may result in revocation of authorization to use the Contraflow Lane.

DRIVE SAFELY AND DEFENSIVELY!

REGULATIONS

1) City of Houston Ordinance #79-1214 adopted on July 25, 1979 provides for the enforcement of certain restricted access lanes for mass transportation services designated by the State Department of Highways and Public Transportation Commission, and for the removal of vehicles causing a hazard to the operation of a restricted access lane.

2) It shall be unlawful for any person, other than a driver or passenger within an Authorized Vehicle, to operate any vehicle in or upon a restricted access lane during its hours of restriction.

3) Any person violating these provisions shall be guilty of a misdemeanor and shall be assessed a fine not to exceed $200.00.

4) An "Authorized Vehicle" means (i) a METRO motor vehicle; and (ii) a motor vehicle authorized to use the Contraflow Lane as prescribed by METRO, which motor vehicle bears an identifiable Contraflow authorization decal displayed pursuant to the requirements of METRO.

5) All authorized drivers must abide by these Rules and Regulations and changes developed from time to time pursuant to the Contraflow Operations Agreement by and between METRO and the State Department of Highways and Public Transportation.

6) Violations of the Rules and Regulations may result in METRO's revocation of authorization for the vehicle and driver to use the Contraflow Project.

Contraflow lanes worth trying

Although the idea of buses barreling along at 55 miles an hour on the wrong side of the North Freeway is at first rather discombobulating, the proposed contraflow express bus lanes plan is worth trying if proper safety precautions are taken.

The North Freeway is heavily congested during morning and afternoon rush hours, and freeway mishaps often create a temporary parking lot. However, traffic is relatively light on the opposite side, where one lane easily could be spared to accommodate the buses, as is planned.

City Transit Administrator Barry Goodman says that ample safety measures will be provided, such as cones and overhead signs to mark the lanes. This, of course, will be necessary. The contraflow lanes for downtown's minibuses have worked well, with no serious problems reported, but it must be remembered that the minibuses travel about 25 miles per hour while the freeway buses will be going twice as fast or more.

Coupled with a park-and-ride facility in the Steubner-Airline and North Shepherd area, the express buses should provide an attractive alternative to driving the congested freeway downtown. The contraflow lanes also will help the many commuter buses now using the freeway. There could be an appreciable reduction in the number of cars on the freeway as a result.

Although a considerable amount of city and federal funds will be required to establish the express bus lanes, there will be a minimum of construction involved that would be wasted should the project be deemed impractical. As in its minibus project and park-and-ride routes, the city is again approaching the transit problem with a plan that is flexible, a necessity when dealing with something so unpredictable.

The plan has the ingredients for success and certainly deserves a trial.

Houston Chronicle 8/13/77

Work scheduled on I-45 contraflow plan

The Texas Department of Highways and Transportation will be preparing a section of the North Freeway (Interstate 45) for the planned contraflow bus lanes by installing "control elements" at various entrance ramps each night this week from 10 p.m. to 6 a.m.

The "control elements" will be similar to the ramp metering system currently used in other areas of the city.

The contraflow project will use an existing, outbound lane in the morning exclusively for inbound, express buses, and will reserve an inbound lane exclusively for outbound, express buses in the afternoon. The lanes will run from downtown to the N. Shepherd-Steubner Airline area.

During the work hours on the installation, the two outer south bound lanes of I-45 will be closed from Blue Bell Road to Quitman.

After the devices are installed, the department will begin similar work on the northbound side. During work on each ramp, that ramp will be closed.

In conjunction with the contraflow project, the northbound lane of I-45 between Quitman and Shepherd will be closed from 7 a.m. to 3:30 p.m. Wednesday for drilling of holes for concrete supports.

Two inside lanes of I-10 eastbound will be blocked from Wilcrest to the West Belt for pavement repair from 9:30 a.m. to 3:30 p.m. Wednesday. When work is completed, the outer lane will be blocked for similar repair. The entrance ramp eastbound at Wilcrest also will be closed during that time.

One inside north bound and southbound lane of I-45 from Sims Bayou to north of Broadway will be closed from 9:30 a.m. to 3:30 p.m. Wednesday for cleaning of the median area.

Houston Chronicle 6/20/78

Editorials

Ideal time for a long look

Work on the contraflow lane project on the North Freeway is drawing considerable attention these days, with drivers and passengers trying to figure exactly how the buses will use those entrance and exit ramps and that strange crossover at Loop 610.

The construction is in such a prominent place on the freeway that it affords a fine advertisement of the city's efforts to do something about Houston's worsening traffic.

And a good point can be made for the fact that when the freeway traffic is at its worst, the motorists get their best and longest look at the work going on along the median.

Monday, August 28, 1978
Houston Chronicle

Houston Chronicle Aug. 28, 1979

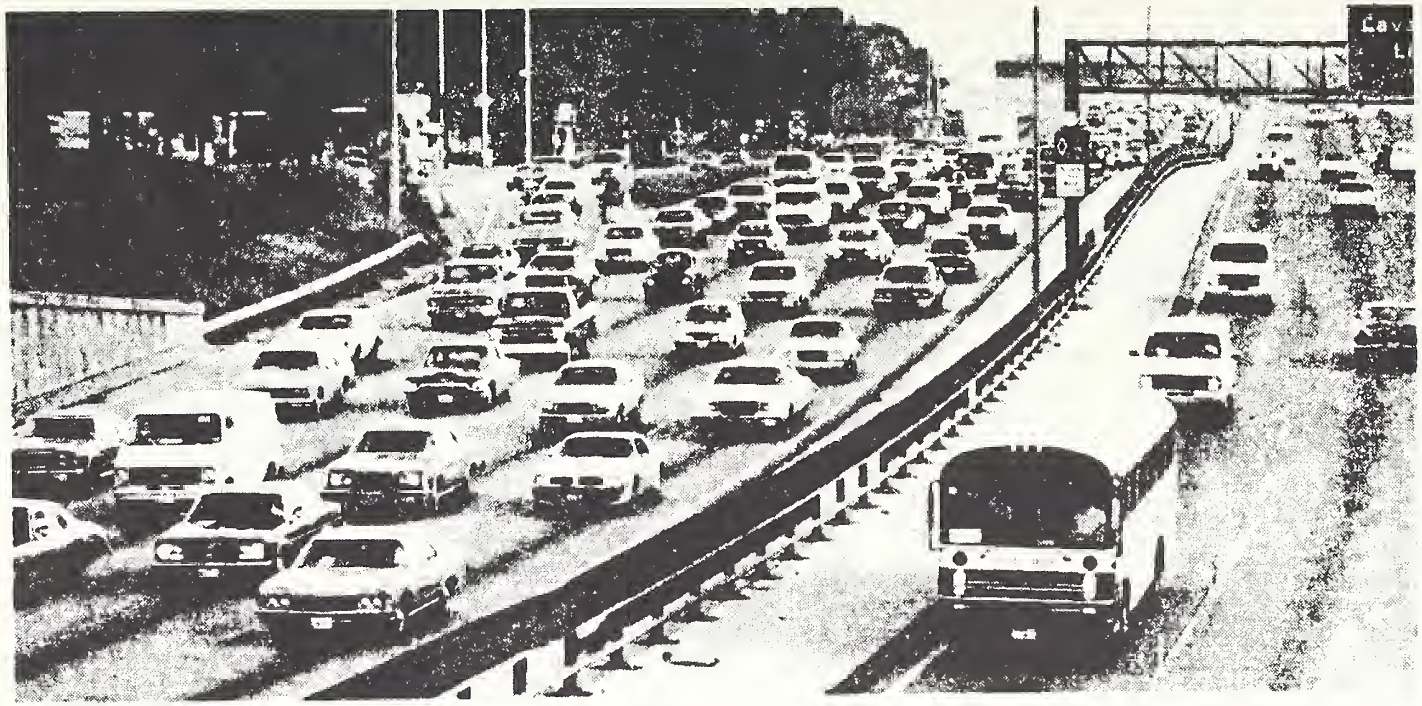

Photo by Curtis McGee, Chronicle Staff

Contraflow traffic zips along at about 50 miles per hour toward downtown Houston at 7 a.m. today in outbound lanes, right, of the North Freeway. Regular inbound traffic creeps at about 20 mph, left. Today was the first day of operation of the contraflow lanes, which are restricted to Metro buses, airport buses and registered van pools. In the afternoon, the contraflow traffic will flow on the inbound lane. Removable rubber pylons separate the contraflow lane from the regular lanes.

Houston Chronicle Aug. 28, 1979

Contraflow 'working,' officials say

BY SUSAN LEVINE
and JOHN KLING
Chronicle Staff

Public officials who today inaugurated the North Freeway's contraflow lanes said they will talk with state Highway Department officials about establishing exclusive bus lane service on other freeways.

Mayor Jim McConn, County Judge Jon Lindsay and Metropolitan Transit Authority Board Chairman Howard W. Horne, who rode on the system for the first time today, were enthusiastic about the contraflow system.

McConn said, "I was impressed. We breezed right along with no problems." Lindsay said it cut his commuting time over the 9.6-mile contraflow distance from 40 to 10 minutes. Horne smiled and said, "It's working."

The lane, which opened today, helps extend MTA service to the Farm Road 1960, Champions and Greenspoint Mall areas.

McConn said he feels there are sufficient warning lights on the freeway to minimize collision hazards but conceded that some accidents may occur.

Under the contraflow system, the outside freeway lane for northbound traffic is marked off by pylons during the morning traffic hours and reserved for use by southbound MTA buses, contracted private buses and approved van pools. Then in the afternoon, the process is reversed and a southbound lane is marked off for use by similar northbound traffic.

McConn today said he would like to see separate-lane service for buses and van pools extended south to the Gulf Freeway, possibly by constructing a separate lane on the freeway median or by widening the freeway.

MTA Executive Director Barry Goodman said the contraflow system is feasible only on the North Freeway, but said the other options will be considered on other freeways.

The 9.6-mile contraflow lane runs from the Stuebner-Airline, N. Shepherd area to Smith and Louisiana on the north edge of downtown.

Horne said ridership on the contraflow should be monitored for a 90-day test period. If ridership is high, he said, the state Department of Highways and Public Transportation would be likely to approve construction of the extended exclusive bus lane.

No immediate estimate of ridership on the first day of the contraflow service was available, Goodman said.

He predicted that although ridership appeared low, it will increase.

Drivers of two van pools were pleased with the contraflow system, despite the fact that it didn't save them a great deal of time in getting to work during the early morning hours.

Margaret Clower and William H. Chambliss, Conoco employees who drive company vans, said the time they gained on contraflow was lost stopping at red lights getting through downtown on the way to Greenway Plaza. Previously, they said, they used surface streets to avoid the congestion of the freeway and downtown streets.

"Initially I was a bit concerned by the oncoming traffic, but overall the whole group decided it was safer and more pleasurable than out in the rat race of the main freeway," said Chambliss, a Conoco business analyst.

Both drivers said they were driving on the system between 6:15 and 6:30 a.m., prior to the heavy rush hour. They said drivers later in the morning when traffic is heavier would probably benefit more from the system.

Both agreed that they will probably save more time in the afternoon when traffic on the North Freeway heading outbound is always much heavier.

"I see this contraflow as a real asset for the afternoon drivers," said Clower, a personnel analyst in the exploration division. "But they need a way to speed people through downtown who don't work downtown."

Although officials were happy with today's run, some potential users of the tax-supported MTA's contraflow lane service are upset over the service's $60 monthly fee, only $10 less than that previously charged by a private company in the area.

MTA has contracted private buses to operate from the far North Freeway sections, via the contraflow lane, to downtown.

Riders are angry that, despite their sales tax subsidy of MTA, its service will cost only $10 less than that of Oliver Bus Lines, which has operated in the area for nearly five years and has run seven buses daily into Houston.

Oliver will continue running but now under the MTA aegis. It is expanding to 14 buses for one express route and a Park & Ride route, with a second firm operating seven buses from a Greenspoint Mall Park & Ride lot into town.

Many at the meeting described Oliver's service as excellent. They expressed fear that service will deteriorate under the authority's supervision and complained they had had no input into how MTA service would be extended to their area.

"We already are getting better service than any other part of town, without any help of yours," attorney Paul Long told MTA officials.

MTA "just barged in here to justify our paying the sales tax," he said, and the agency should have let private enterprise continue on its own.

But even with the $60-per-month fare — about double that charged on other MTA Park & Ride routes — Linda Cherrington, MTA director of program development, said, the authority will only recover 60 percent of costs incurred on the North Freeway runs — and that is if buses are filled to 105 percent.

She said the $60 charge was the lowest the board would allow. Board members initially had demanded an 80 percent recovery rate, she said. Ms. Cherrington said the more expensive fare on these routes is justified because the quality of service will be so high. "Our service on the other Park & Rides is horrible," she conceded.

The $1.8 million expense of building the 9.6-mile contraflow lane — with 80 percent paid by a federal grant — did not contribute at all to the fees on the service routes, Ms. Cherrington added.

She said sentiments expressed Monday were contrary to earlier complaints that MTA was not serving the North Freeway areas even though residents there were subsidizing its operations.

The meeting was designed to answer riders' questions and explain route changes and scheduling. If Monday's session was any indication, persons in the area feel that many problems remained to be ironed out.

Houston Post Aug. 29, 1979

Contraflow has successful debut

By TERRY KLIEWER
Post Reporter

The North Freeway contraflow project opened with considerable fanfare and, more importantly, without incident Tuesday, and pleased public officials immediately called for extension of transit-only lanes farther north on the freeway and then onto other freeways.

Everyone seemed happy with the project's first-day success during both morning and afternoon rush-hours. But attention was already turning Tuesday to the prospect of extending the 9.6-mile-long contraflow sector farther north to improve its efficiency, particularly during morning rush-hour periods.

In fact, in an otherwise sterling inaugural day of contraflow operations, the biggest problem to surface involved traffic tie-ups in the morning at the northern end of the contraflow sector beyond the freeway's intersection with North Shepherd.

At that point, where contraflow ends, traffic backed up and virtually stopped Tuesday morning, meaning that buses and vans headed to the northern entrance of the inbound contraflow lane were also slowed to a snail's pace.

That could be on its way to solution within the next 90 days, however.

Howard Horne, chairman of the Metropolitan Transit Authority, said contraflow's performance over the next three months will determine the timetable for planning a northward extension of the contraflow sector, perhaps as far as Greens Road.

But Horne and others cautioned that much still depends on the amount of business generated by the present contraflow project. Tuesday's activity was heartening for a first day of operations but fell substantially short of MTA expectations for contraflow use in coming weeks.

The transit authority reported that 1,458 persons rode express buses or company vans, in MTA-authorized van pools, during Tuesday's morning rush-hour contraflow operations. They were distributed on 27 bus trips and 96 vans.

By contrast, the MTA is looking for at least 2,500 passengers on contraflow per rush-hour period to consider the project successful. But MTA officials were confident Tuesday that their contraflow projections will be met.

So were a cross-section of political leaders who turned out for contraflow's inauguration Tuesday morning.

Houston Mayor Jim McConn, who joked about being a "white-knuckled" first-time contraflow rider, took a special dignitaries' bus along the inbound contraflow lane and returned a convert, calling for contraflow experimentation on other area freeways if possible.

Harris County Judge Jon Lindsay called contraflow "a very significant first step in Harris County public transportation. If this will prove itself, many more steps will follow in the future."

Ray Barnhart, a member of the State Highways and Public Transportation Commission, admitted he was skeptical of the contraflow concept. After Tuesday's demonstration, he said, "I still want to see if it's cost-effective, but I now believe it will be."

And bus riders seemed confident about contraflow's future, too. Ironically, two of the riders who talked with The Post said they spent at least as much time getting to work on contraflow buses Tuesday as they would have spent in their own cars. But they still endorsed the project.

Gayla Murphy, an Exxon computer operator who made a contraflow round-trip between Greenspoint Mall and downtown Houston Tuesday, said the express bus service frees her from worry about downtown parking.

"I thought it was great," she said. "My bus passed cars right and left, and I felt safe all the way. The problem today was that not many people know about the park-and-ride lots."

Murphy, Elkovich and Gloria Rupert, the driver of one of the Greenspoint buses, agreed the MTA hadn't promoted the new park-and-ride service sufficiently in recent weeks. "There should have been more advertising," said Rupert. "People in Houston need to be taken by the hand and led onto a bus."

Tuesday's ridership of contraflow express buses was low at both Greenspoint and at Bammel Road Church of Christ. A third express bus route through the Farm Road 1960 area fared much better, but even so, the three express routes' total of 27 bus trips netted only 594 riders.

Van pools made up much of the slack, however. Officials counted 96 vans inbound via contraflow Tuesday morning, carrying 864 riders to various central Houston locations.

As it happened, a Woodlands van pool was the first vehicle on the inbound contraflow lane about 6:22 a.m. Tuesday, and vans clearly predominated outbound contraflow traffic again in the afternoon.

In an outbound Gulf Oil Corp. van pool Tuesday afternoon, the passengers were quietly pleased that contraflow allowed them to whisk past stop-and-go traffic on the opposite side of North Freeway near Loop 610.

"I like it," said Frank Kincaid, a Gulf internal control analyst who lives in the Farm Road 1960 area. "I had some concern before it started, but I don't now. I feel completely safe."

Van driver Bob Myers, a personnel administrator for Gulf, said contraflow allowed the group to shave about 10 minutes Tuesday off its normal travel time from northern Harris County to downtown Houston.

His new Ford van carried eight riders, including himself, at a steady 45 mph, past generally sluggish and sometimes stalled traffic on the non-contraflow side of North Freeway.

Myers said driving contraflow poses no problems — "It's like driving down any two-lane highway" — and he predicted that contraflow van traffic will grow faster than bus traffic in coming weeks. "This is just what some people have been waiting for to start van pools" said one of Myer's passengers.

While the potential for accidents has been much discussed in connection with contraflow, police reported no problems Tuesday. Nevertheless, officials were philosophic about accident prospects. Both Horne and McConn agreed that a mishap is inevitable and said the public should try not to make too much out of accidents that occur.

Horne pointed out that "We have accidents all the time in Houston, and the public accepts that. If the accidents are viewed in (proportion) to the contraflow lane's use, the public will accept that, too." If accidents become too frequent, he added, the MTA will take corrective actions.

Houston Chronicle Sept. 21, 1979

Viewpoints

Contraflow defender states reasons why

From Karl E. Wolff Jr., 207 Vashti.

As I was getting dressed this morning I happened to notice a letter, "Contraflow lanes are jamming traffic" (Viewpoints, Sept. 14), which my wife had put on the dresser for me to see. Since I am a vanpool driver who uses the contraflow lane, I felt I had to write in defense of contraflow.

I have driven the contraflow lane every morning and afternoon since it opened and noticed how it has slowed traffic to some degree; something to be expected. Indeed, the traffic from W. Mount Houston to Airline may now take 10 minutes instead of five; however, the contraflow idea was put into operation to try and remedy a much larger problem than to create the small one the letter writer tags to it. Studies were made on traffic patterns of I-45 during peak hours to determine the feasibility of a contraflow lane before it was put into operation and the decision was made to go ahead.

As more people see vanpools and buses using the benefits of contraflow, they too may decide to join park and ride or vanpools, alleviating a far greater problem on the opposite side of the freeway. Therefore, I suggest to the letter writer, that with the same conscious judgment he used to find a job away from downtown, he find another route to work that may be better.

Houston Post Sept. 14, 1979

Viewpoints

Contraflow lanes are jamming traffic

From Leny Trichel, 8210 Colgate.

I am strongly opposed to the recently instituted contraflow lanes on IH-45. Contrary to the television and radio reports, there is massive congestion on the lanes which once flowed freely, particularly between Airline and West Mount Houston Road. For those of us who very consciously choose employment away from the traffic congestion, it is very frustrating to be penalized by those who failed to exercise such judgment.

There is an extremely small number of passengers in the vehicles which utilize the contraflow lanes, making the sacrifice even worse. My driving time has increased threefold!

In the past fortnight I have observed the following events: Frustrated motorists exiting on entrance ramps and anywhere else one could get off, a routine use of the shoulders, a double-wide trailer totally occupying both lanes while the police were idly watching, and a host of related unsafe practices.

I also want to mention that the lights of the officers observing the contraflow lanes automatically bring traffic to an absolute halt. Please have them turn these off!

Lastly, if MTA officials want to observe the conditions as they really are, they are welcome to catch a ride with me anytime they are ready!

Houston Chronicle Sept. 30, 1979

Contraflow operation called success thus far

BY JOHN KLING
Chronicle Staff

The North Freeway contraflow lane has been a success during its first month of operation, Metropolitan Transit Authority officials say, although they concede freeway traffic has jammed up more than expected.

"The first month's operation has been a tremendous success," said outgoing MTA Executive Director Barry M. Goodman, noting that ridership has risen faster than anticipated and no accidents have occurred on the lane.

"I think it has been perfect," he said. "We found that we can operate it safely and with little disruption."

Some who drive against the direction of the contraflow project disagreed, saying they are being greatly inconvenienced and only a few benefit from the project which "borrows" one lane in the opposite direction of rush hour traffic for the exclusive use of buses and van pools.

"All six lanes (of the North Freeway) are crowded the better part of the day now," said Charlene Raus, who works near Greenspoint Mall, but lives in Inwood Forest in northwest Houston. "By taking one lane away, they haven't accomplished anything but confusion."

"One of the reasons I transferred my job out here was so that I wouldn't have to fight that traffic and now I'm fighting more," said John Morris, an employee of Amoco International Oil Co., also near Greenspoint Mall, who lives in the Candlelight Oaks subdivision in northwest Houston.

Robert Hineman, director of urban planning for the Woodlands Development Corp. who lives at 4224 Judson in West University, said he favors the contraflow system but said it should be a permanent, separate lane.

Hineman said he and other members of his car pool have not found an alternate route to the Woodlands and the contraflow lane adds at least 10 minutes to their trip in the morning and as much as 30 minutes in the afternoon.

Goodman and Chuck Fuhs, a senior MTA planner who helped design and supervise the contraflow project, said the trade-off is fair and will become more acceptable as more commuters turn to contraflow bus service taking cars off the freeways.

Total daily ridership during the fourth week of operation reached an estimated 1,729 passengers, a 48 percent increase over the first week's total of 1,170.

The daily total included 699 persons on 30 MTA contracted buses and 1,030 riders on 107 van pools.

The MTA's goal is a total of 2,500 riders and Fuhs estimated that goal would be easily reached before the end of the 18-month test period.

He said the capacity of the 9.6-mile lane that runs from Steubner-Airline North Shepherd in the north to downtown Houston is virtually unlimited.

Goodman said the only major disappointment has been at the Greenspoint Mall Park & Ride lot where fewer than half of the 400 available spaces are being used.

The MTA also operates a lot at the Bammel Road Church of Christ, FM 1960 at Fritz Road, and existing service on FM 1960 also uses the contraflow system. Two additional Park & Ride lots are scheduled to open late this fall.

Fuhs said outbound speeds in the morning when a lane is borrowed from the northbound side of the freeway have nearly returned to normal as motorists become more familiar with the project, its pylons, blinking lights and police enforcement.

He said that when the project first opened in late August drivers actually pulled up next to the crews inserting pylons from a moving truck and stopped to see what they were doing.

He said "rubberneckers" are still causing some problems, but that the situation has eased.

While morning, outbound traffic is near normal, Fuhs said that the logjam in the afternoon when the lane is reversed is worse than expected. He said cars start backing up as much as a mile or more before the start of the project at Steubner-Airline/North Shepherd and come to a virtual halt as the three-car lanes are reduced to two.

Average speed from Beltway 8 to Hogan is 35 mph in the afternoon, he said, down from an average of 50 mph before the project was opened. He said travel time over that distance has increased from about 10 minutes to 20, but conceded that when traffic comes to a virtual halt, psychologically, it seems like 30 minutes or more.

Fuhs said an average travel speed of 35 or 40 mph is acceptable, but said Houston motorists probably won't tolerate it without complaint.

"It is safer at 35 or 40 (mph)," he said, but it does not improve our public acceptance."

He said, however, that a number of proposals are under consideration by the state Department of Highways and Public Transportation to ease congestion and boost the average speed.

These include closing some entry ramps to divert drivers to frontage roads, metering ramps to regulate the flow of traffic and synchronizing traffic lights on major nearby roads to speed inbound traffic.

He said most cars inbound on the North Freeway in the afternoon are heading to Loop 610 and could get there quicker by using surface roads if the proposals are put into effect.

Mrs. Raus of 7018 Deep Forest, an employee of Endicon Property Management Corp. at 30 North Point Drive, said the frontage and feeder roads are already jammed by drivers trying to get off the crowded North Freeway.

Both she and Morris, of 5006 Droddy, said they are now forced to take surface roads home because of the congestion, but they said the contraflow project has increased their travel time by at least 20 minutes in the afternoon.

Fuhs said another logjam where the Katy Freeway empties into downtown Houston at Smith will correct itself when resurfacing work on I-45 is completed, allowing drivers to get off on other downtown exits.

Fuhs said the project has been remarkably free of incidents during the first month and police agreed.

Capt. W.T. Higgins, head of the police traffic bureau's point control, said incidents have been minimal and only "two or three" persons have been stopped for violating the lane regulations.

He said his office has received few complaints from irate motorists complaining about traffic logjams.

The MTA contracted for police enforcement during hours of operation and currently two motorcycle officers and two traffic control cars are used to patrol the lane.

Despite complaints from some drivers, Goodman said the contraflow lane is the only service currently provided by the MTA about which no complaints have been received from riders. A recent survey of riders found overwhelming support for the system, he said.

Houston Post Oct. 10, 1979

Sound-Off

Money-making idea for contraflow lane

It's 5:30 in the afternoon and I am driving north on the North Freeway between five and 10 miles an hour and frequently stopping in this "parking lot" of northbound traffic.

On the southbound side, to my left, is the contraflow lane, which is vacant. I have been watching it for over a mile and have not seen a bus, van, or any other vehicle traversing it. The red X's are visible and the little yellow posts have been installed and will be picked up again in an hour or so.

. . . With me in this slow traffic is a Trailways bus with a Chicago-bound sign on it. There is a taxi-cab apparently headed for the Intercontinental Airport with some passengers anxious to make their plane . . .

I would like very much to . . . use the contraflow lane (since nobody else is) . . .

Would it be possible for the MTA to sell the privilege of the use of the contraflow lane to inter-city buses, taxi-cab companies, and poor blokes like me? I guess that as many as 1,000 cars could use the lane without making a dent in its dedicated purpose. Such a privilege might be worth up to $15 a month. That would mean $180,000 extra income annually to the MTA. This is probably equal to or more than the cost of maintaining the . . . lane. I could pay in advance for a windshield sticker and would . . . take whatever training MTA might request to insure safety.

Wendell S. Loomis

808 Travis, No. 1012, Houston, Texas 77002

Houston Chronicle Nov. 27, 1979

Photo by Buster Dean, Chronicle Staff

First contraflow accident

The first accident in the new contraflow lanes on the North Freeway involved a head-on collision Monday morning between the truck at left and a pickup truck, right, driven by Metropolitan Transit Authority employee Sylvia Royster. The driver of the truck, Joe Mike Venegas, said he swerved into the contraflow lane to avoid colliding with a vehicle in front of him. No one was seriously hurt. The accident occurred on the outbound side of the freeway. The MTA vehicle was picking up pylons used to mark the inside outbound lane, which is used exclusively by buses during morning hours. The vehicles had been moved from the place of impact before this picture was taken.

Houston Chronicle
Oct. 23, 1979

Traffic jam

Congressman's study of MTA's contraflow is delayed by a snarl on the North Freeway

A congressman visiting Houston to study the city's transportation problems has already experienced one of them. A traffic jam on the North Freeway prevented him from taking a first-hand look at its contraflow lanes.

However, U.S. Rep. Robert Duncan, D-Oregon, said his research has involved him in similar tie-ups in many other cities, so the Monday morning snarl here did not give him a negative impression of Houston.

Duncan is a member of the House Appropriations Committee and chairman of the Subcommittee on Transportation. He said he tours cities all over the country, studying bus, rail and other transportation systems.

Duncan said he is focusing his attention on the contraflow lanes that the Metropolitan Transit Authority has established on the North Freeway, and on CarShare, the MTA's computerized carpool program.

He spoke favorably of the 1-cent sales tax that residents of Houston and some outlying areas approved last year to finance MTA operations.

"I think it's encouraging that you've gone ahead and taxed yourself," he said. "You can expect continued (federal) support for capital investment of local transportation systems, but this support will depend on the extent to which local people are willing to back up their own ideas with their own money."

Duncan predicted that the competition for federal transportation funds will increase, and that willingness to provide local funds will give Houston an advantage in seeking assistance from Washington.

"The ones that are prepared to help the most are the ones that will get help from Washington," he said.

Duncan declined to pass judgment on the MTA's often-criticized bus operations. "It's normal to experience lots and lots of problems when taking over a failing private business," he said.

Duncan predicted that few, if any, local railway systems would be built in the near future. They are simply too expensive compared to other forms of transit, he said.

Duncan said he is encouraging banks, grocery stores and other businesses to transfer employees to branch operations close to their homes. Some employees who must drive across town could be working only a short distance from home, he said.

Houston Post Jan. 10, 1980

Collision in MTA contraflow lane involves 4 vehicles, no bad injuries

A four-vehicle accident early Wednesday involving traffic on the Metropolitan Transit Authority's North Freeway contraflow lane resulted in no serious injuries, police reported.

Investigators said a passenger van southbound in the contraflow lane was struck by a northbound compact car about 6:55 a.m.

The compact car entered the contraflow lane after a collision with a tractor-trailer rig as the two vehicles exited Loop 610 onto northbound North Freeway. It then re-entered the northbound freeway traffic adjacent to the contraflow lane, where it collided with another car, police said.

The accident stopped traffic on the contraflow lane for about 20 minutes.

Police identified the driver of the compact as Mugurel Emanoli Lup of 6727 Telephone Road, Apt. 247. Police ticketed him for negligent collision and for failure to have a valid driver's license.

Police said the only injury was minor and occurred to the driver of the second car, Greg Steven Jankowiak of 2840 Westside in Pasadena.

The van was used for employee vanpooling by Gulf Oil Corp., and it was authorized by the transit authority to use the contraflow lane.

Metro Executive Director Walter Addison pointed out that the accident was the first on the contraflow lane which has involved an authorized contraflow vehicle. One other minor accident related to the lane's operation occurred last fall, but it did not involve contraflow traffic.

Its relatively good safety record "doesn't diminish the fact that (the project is) potentially dangerous," said Addison. "That's why we've been cautious and deliberate (about its users)."

MTA officials unsure about contraflow use by car pools

By TERRY KLIEWER
Post Reporter

The Metropolitan Transit Authority has quietly reached its initial ridership goal for the North Freeway contraflow lane project, but Metro officials are hesitant to take the obvious next step — adding car pools — to boost contraflow use even higher.

Though final figures are not yet available, the contraflow project appears to have carried more than 2,500 persons, in both buses and van pools, each rush-hour period every day this week. That was the ridership goal originally set for the project when it opened last August.

But there is clearly much more room for traffic along the contraflow lanes. By one official reckoning, the project has room to handle as many as 300 vehicles per hour instead of the 365 per day it now carries.

The obvious next step would be to allow car pools onto the lanes for rush-hour trips between northern Harris County and central Houston. Right now, car pools are banned.

The car pool idea has been suggested several times, most recently by state Rep. Don Henderson, chairman of the Legislature's transportation committee.

In a recent letter to Metro Executive Director Walter Addison, Henderson pointed out that the contraflow lanes "appear to be under-utilized considering the magnitude of removing one lane of traffic" from normal rush-hour use.

Henderson said allowing car pools onto the lanes would both spur car pooling and boost contraflow use.

That may be true, concedes Addison, but putting car pools on the lanes isn't as simple as just opening up the gates. "It's a complicated matter," he says.

For openers, any change in the type of traffic allowed on the lanes must be agreed to by the principal agencies involved in its operation — the state highway department and the transit authority — and at least discussed with other agencies like the Houston Police Department, which provides traffic enforcement for the project.

And, Addison explained to Metro board members this week, the project's users must meet steep insurance requirements. The present liability, personal injury and physical damage coverage that is called for may cost more than car pool operators could afford.

Finally, and probably most apparent, is the question of whether contraflow car pools would be safe.

To assure the safety of the buses and privately owned vans which now use the lanes, the MTA requires vehicle inspections and driver training beforehand. Presumably, those same requirements could be applied to passenger cars. But the application could be cumbersome, especially for car pools which rotate drivers and cars.

Nevertheless, new Metro Board Chairman Dan Arnold urged Addison to look further into the car pool idea. "If people can meet the requirements and we have the capacity, we ought to examine this further," he suggested. Addison agreed.

The chief impetus behind the idea of allowing car pools onto the contraflow lanes is probably what Henderson pointed to — the project's relative under-utilization.

The project operates on the principle that, because of lopsided traffic distribution on the North Freeway during rush hours, the lightly traveled side of the freeway (outbound in the morning, inbound in the afternoon) can afford to surrender one lane to "wrong-way" contraflow bus and van traffic.

But that loss of a lane occasionally contributes to additional traffic congestion and slowdowns on the lightly traveled freeway side. And that, in turn, breeds frustration in the slowed-down drivers when they see the contraflow lane vacant of transit traffic for minutes on end.

At the same time, rush-hour car pools must creep along in the stop-and-go traffic on the heavily traveled freeway side. Their trips along the North Freeway will take at least 10 minutes more to make than will be required for the contraflow vehicles, which whisk along at 40 mph.

Addison says five vehicles per minute on contraflow would be a good rate of traffic flow for the project. Traffic flow now averages about one vehicle per minute — which suggests, in rough terms, that the project is about at about 20 percent of capacity.

But contraflow use has hardly peaked, even if it is restricted to just van and bus traffic. The project opened last August with about 1,500 passengers per rush-hour period on 27 bus and 96 van trips.

It has grown steadily, despite holiday downturns and a handful of attention-getting accidents, to a mid-January level of just under 2,500 passengers per rush-hour period on a minimum of 37 bus and 140 van trips. Last week's ridership was even higher.

And, Metro officials say, there are still 800 unused parking spaces to be filled in its just-opened park-and-ride lot on Kuykendahl near the North Freeway and another 750 that will be opened about March with the dedication of yet another new park-and-ride lot. That new lot will be at the intersection of Stuebner-Airline and North Shepherd.

Contraflow lane crash kills driver

By BARBARA MARTIN
Post Reporter

A Houston man was killed Friday in a collision on the North Freeway contraflow lane — the first fatality on the lane since inception last August.

Marilee Wood, executive assistant to the Metropolitan Transit Authority's board, blamed the accident on rainy weather and said an MTA investigation showed the accident "could have occurred anywhere and had nothing to do with the contraflow lane."

Ronald Remie, 24, of the 4100 block of Hershe was killed instantly about 7:45 a.m. when his car — traveling in a northbound lane in the 2000 block of the freeway — skidded out of control into the southbound contraflow lane, police said.

Remie's car collided with a Woodlands Commuter Service Inc. van traveling south in the contraflow lane, police said. Remie was employed at Houston Lighting and Power.

FOUR PASSENGERS IN THE van and its driver were injured. Only the driver, Wesley Martin Smith, 39, of the 300 block of Blue Ridge, required hospitalization.

Smith was admitted to St. Luke's Hospital where he was treated for a broken sternum, a broken rib and a fractured kneecap.

Smith, who has been driving a commuter van for about two years, said, "The other car just skidded into our lane. There wasn't anywhere to go. We had to hit him."

He said Remie's car was skidding sideways. "I didn't see him until he was crossing over into our path."

A van passenger, Al Abbott, 33, of the 3400 block of Kentwood said, "The guy swerved into our lane and we hit him. It could've happened at any time when the pavement is slick."

ABBOTT, WHO SAID HE HAS been commuting to his downtown job with an oil company about two years, said he feels "as comfortable traveling on the contraflow lane as any other lane on a freeway. This was just an unfortunate incident."

The contraflow lane concept is used only on the North Freeway — Interstate 45 north of Loop 610 — during peak traffic hours, 6 to 8:30 a.m. and 4 to 6:30 p.m.

Editorials

Extending contraflow lane only extends congestion

Pity the person who has to drive into Houston on the North Freeway between 3 p.m. and 7 p.m. Monday through Friday. During that time the Metropolitan Transit Authority's outbound contraflow lane takes out one normal traffic lane from North Shepherd to downtown; the result is always inconvenience and sometimes chaos.

The morning traffic problem is almost as bad, with the contraflow lane taking up one outbound lane and resulting in excessive crowding for the remaining lanes.

Meanwhile, the contraflow lane sometimes appears to be unused except for the hustle and bustle of police cars, MTA cars and trucks when the yellow pylons must be put down and removed.

True, there is a steady flow of vans and buses that are bound to take some cars off the freeway, but the contraflow lane by taking up one lane of a busy freeway causes more of a traffic snarl than it alleviates.

There were some doubts at the onset about whether the North Freeway traffic would lend itself to contraflow, since there was an increasing amount of traffic both ways during the morning and afternoon rush hours. The past few months have dispelled the doubts: All the freeway lanes are needed to carry the normal traffic.

Now the MTA has taken the initial step to extend the contraflow lane another three miles north, from North Shepherd to West Road. Instead of 10 miles of confusion and congestion, there will be 13, and who knows how many more eventually.

This is not the sort of thinking that will win the MTA the support it needs to build a successful public transit system in the Houston area.

Houston Chronicle 6/2/80

Viewpoints

Contraflow lane does help traffic

From Walter J. Addison, Executive Director, METRO, P.O. Box 61429.

I read with concern your editorial entitled "Extending contraflow lane only extends congestion" (Chronicle, June 2). Several points were made which require correction and clarification.

I must take issue with your comment that the North Freeway contraflow lane "appears to be unused." Today, contraflow carries over 8,000 commuters in buses and vanpools. During the afternoon peak-hour contraflow passengers represent 25 percent of all persons moving in the outbound direction on North Freeway.

While I agree with you that maximum utilization of freeway lanes is required to carry normal North Freeway traffic, the contraflow operation has precisely that effect. The activity on contraflow is greater than an equivalent freeway lane of normal peak direction traffic. Over 30 percent more people are being moved on North Freeway since the introduction of contraflow. This improvement in total person movement is significant by all counts.

Also, please note that the Metropolitan Transit Authority is not extending the contraflow lane as your editorial lead states. The State Department of Highways and Public Transportation has proposed to convert the median shoulder of the North Freeway southbound lanes from West Road to North Shepherd as a concurrent lane for authorized vehicles. The purpose of the improvement is to give morning preferential access to the contraflow lane for authorized vehicles. The only impact to adjacent freeway lanes will be a reduction of morning peak hour traffic congestion by allowing transit vehicles preferential bypass, thereby encouraging further utilization of contraflow and increasing productivity of buses and vans. The Metro board unanimously concurred in the state's proposal.

Finally, I want to point out that MTA does not intend contraflow to be the permanent answer to transit demand on North Freeway. But the project has made a big step toward meeting Metro's purpose: To show that preferential freeway treatment of transit can work. Now we must move to find the permanent answers.

Houston Chronicle
June 18, 1980

Contraflow buses beat stalled traffic

From D. J. Keel, 8419 Saratoga Forest.

Your editorial (Chronicle, June 2) in which you attacked the contraflow concept is a glaring example of the type of thought that will keep Houston in a public transportation dark ages for years.

The contraflow buses are filled to standing-room-only during the peak rush hour periods. The inconvenience of standing-room-only is, to my way of thinking, preferable to driving 10 or more miles of confused, congested, start-stop, bumper-to-bumper traffic. Houston's automobile population has increased to the point where even four or more additional traffic lanes on the North Freeway would immediately fill to capacity.

Another fact to consider is that each person on the bus represents a minimum of two gallons of gasoline used and one parking space filled if they each drove their car into town. Two gallons of gasoline saved per day by each of the contraflow riders is a very significant amount of energy conserved.

Contraflow has cut commuting time

From C. O. Munson, 2900 North Loop West, Suite 1400.

Your editorial (Chronicle, June 2) concerning Metro's extension of the contraflow lane on Interstate 45 is substantially in error and counterproductive to Houston efforts to increase mass transportation.

I moved from Chicago to Houston over six years ago and have witnessed the continual deterioration in traffic flow on the North Freeway over these years. The institution of contraflow with the resultant decrease in auto traffic is very noticeable. This is, of course, the result of people opting for the no-hassle bus ride over sitting in stop-and-go traffic in their auto.

On the average, my commuting time has lessened by approximately 10 minutes over precontraflow. My observation of traffic flow on the side of the freeway that contains the contraflow indicates little congestion. In the morning, northbound I-45 traffic rarely experiences any slowdown at all. In the evening, southbound traffic does tend to get tight at the beginning of the contraflow lanes — and at times the backup will extend for a quarter of a mile or so. But having experienced this also, I know that the delay lasts only a few minutes until traffic settles into two lanes.

MTA logs one millionth rider traveling on contraflow route

By TERRY KLIEWER
Post Reporter

The North Freeway contraflow lane project passed a milestone Wednesday when a Metropolitan Transit Authority commuter bus boarded the project's 1 millionth passenger.

All signs are that the 2 million passenger-mark may not be far away. Ridership on the buses and vans that use the 10-mile-long project is higher than even the most optimistic predictions of a year ago.

Metro officials are working with state highway department engineers to devise a three-mile northern addition to the existing contraflow corridor, using the North Freeway median to accommodate a one-lane busway that, unlike contraflow, will not rob either side of the freeway of a traffic lane.

The highway department is supervising just-begun consultant studies of the freeway's potential to carry a full-scale median busway from north Harris County to downtown Houston as an eventual contraflow project replacement.

The three-mile northern extension, which could be built and put into operation by next spring, will ease bus and van movement through traffic congestion that develops in morning rush-hour periods at the contraflow project's northern termination near Shepherd. The full-length freeway busway now under study is years from construction and service, however.

Meanwhile, the contraflow project itself, opened in August 1979, will remain a North Freeway rush-hour fixture for the foreseeable future.

"We have no intention to drop the project even if (federal) demonstration grants are used up," Metro Executive Director Walter Addison said Wednesday. Metro will take over operational funding itself.

The project now is handling 260 vehicle trips per three-hour peak period (one morning, one evening). The buses and vans are carrying 9,200 passengers.

That means that, in its busiest 60-minute period each morning and evening, the project is carrying almost the same number of people as two adjacent freeway lanes of bumper-to-bumper car traffic.

And it means, officials proudly point out, that the project has left its tentative beginnings far behind. When contraflow opened, it attracted only 110 vans and buses per peak period and only 1,200 passengers.

With the addition of two new park-and-ride lots along North Freeway, ridership on Metro and private buses ballooned. Now, 60 percent of all contraflow users ride by bus, and the Shepherd and Kuykendahl park-and-ride lots are close to capacity, Metro officials said.

"The added bus traffic is really the significant element," said Dick Kabat, administrative engineer for district 12 of the state highway department.

Kabat admitted his department, sensitive to complaints that contraflow operation might upset traffic flow along the heavily used freeway, "has been gratified that congestion has not gotten worse, despite the overall growth of traffic in the north part of Harris County."

The project allows buses and van pools to cut their North Freeway travel time between north Harris County and downtown Houston to between 15 and 30 minutes during rush-hour periods. Normal traffic takes 45 minutes to an hour.

The project has had four accidents and two fatalities since its inception.

Houston Post 10/16/80

Concurrent Flow Lane Bypasses Congestion

HOUSTON, TEXAS–The Houston Metropolitan Transit Authority and Texas Department of Highways and Public Transportation opened a new 3.3-mile preferential concurrent flow lane on North Freeway recently. The express lane was constructed within the existing median emergency shoulder and provides a bypass around adjacent traffic congestion.

The concurrent flow lane operates inbound from 6 a.m. to 8:30 a.m. and connects to an existing 10-mile contraflow lane. Authorized users include registered and approved buses and van pools.

The concurrent flow extension was first proposed by the State Department of Highways in January 1980. After federal approval was granted, construction began in December.

Improvements to implement the shoulder lane cost about $130,000 and included median signing, restriping of all freeway lanes at bridge structures, and a connector ramp to afford continuity between the concurrent flow and contraflow segments. Houston Metro operates the new lane and provides wrecker support to remove disabled vehicles. Enforcement is provided by the Houston police department, with locations available within the median to cite and remove violators.

The new lane extension is used by about 270 buses and van pools each morning, carrying approximately 4000 passengers. The estimated time savings to each passenger is about 10 minutes over this three mile segment.

The concurrent flow lane, like the adjoining contraflow lane, is an experimental effort to provide short term improvements to critical morning traffic congestion for transit and van pool patrons. Both Houston Metro and the state will continue to monitor these projects to determine how successful they are in improving traffic operating characteristics.

2 officers hurt when patrol car collides with bus

By TONY FREEMANTLE
Post Reporter

Two Houston police officers were in fair condition at a city hospital late Thursday after their patrol car collided with a bus in the North Freeway contraflow lane during rush hour traffic.

The two officers hospitalized at Hermann Hospital were A. Garcia, 20, and R.J. Guerrero, 22, both of whom are assigned to the North Shepherd substation.

Houston police Sgt. C.V. Thompson said Garcia and Guerrero were southbound on Interstate 45 at the Cavalcade exit around 5:30 p.m. when the patrol car driven by Garcia attempted a U-turn into the northbound contraflow lane in front of the path of a Metro park-and-ride bus.

Police said the officers were responding to a call but did not have their sirens or lights on when they attempted their abrupt turn.

No injuries to any passengers on the bus were reported.

The driver of the bus, Willie Martin, 30, said he was heading north on the freeway at 50-55 miles per hour when the patrol car turned in front of him.

"The cop was heading south. Suddenly he turned right in front of me and I hit the brakes but I couldn't miss him," said Martin.

Martin said he slowed to about 30 miles an hour before his bus struck the car.

A passenger on the bus, Robert Jackson, 25, a management trainee at First City National Bank, said he jumped from the bus as soon as the accident occurred and ran over to the patrol car to see if he could help.

"When I got to the door, the driver (Garcia), was screaming into his microphone calling for help. His partner was slumped over in the passenger seat and looked like he was hurt pretty bad," said Jackson.

Martin said there were about 30 people on the bus, which was headed for the North Shepherd park-and-ride station.

Houston Post 9/4/81

Contraflow worker ignores dangers of traffic

BY NANCY STANCILL
Chronicle Staff

From her vantage point 12 inches above the pavement, Rosie Myers purposefully ignores the heavy traffic whizzing by on the North Freeway.

If Mrs. Myers made a practice of watching traffic in the adjacent lane, she might lose her nerve. Cars and trucks veer dizzyingly close to her outstretched arm, sometimes missing it by perhaps six inches.

Instead, Mrs. Myers concentrates on her task, gathering up the bobbing yellow pylons that separate the freeway contraflow lane from two regular, northbound lanes. She sits in a tiny enclosure in the bottom of the specially designed truck, rythmically picking up pylons with one gloved hand and stacking them with the other.

Mrs. Myers is one of 16 contraflow operators employed by the Metropolitan Transit Authority to keep its special lane operating smoothly. Metro spends $600,000 per year to operate the 9.6-mile bus and vanpool thoroughfare, now 2 years old.

The contraflow lane, the only one in Houston and the nation's longest, carries 12,970 daily riders in 778 buses and vans to and from downtown, according to the latest count. Metro officials regard the lane as an unqualified success, one of the troubled system's few accomplishments.

Still, traffic in both directions on the North Freeway is increasing at such a rapid pace that Metro officials hope by 1984 to replace the special lane with a permanent median transitway, which would not displace a traffic lane.

A permanent transitway would not have to be set up daily, nor would it be expensive to operate. Also, Metro officials say, it would not expose Metro operators to the danger they face by working in close proximity to traffic.

Mrs. Myers, a petite, vivacious woman, recently won a "roadeo" sponsored by Metro to test the skills of the contraflow workers.

To win the "roadeo", Mrs. Myers, 36, scored well on a truck inspection and a written test and expertly maneuvered a truck through a difficult obstacle course set up to test driving skills.

Mrs. Myers gets up at 2 a.m. so she can commute 25 miles from her Missouri City home to arrive at the North Freeway contraflow office by 3:30 a.m. The "a.m. crew" of eight workers, first inspects the lane, removing disabled vehicles and other obstacles, before beginning to "plug in" the pylons at 4:30 a.m.

Mrs. Myers and the other workers rotate their jobs during the work week, "plugging" and picking up the pylons several days and serving as wrecker and pylon truck drivers on other days. The morning crew works from 3:30 a.m. to 11:30 a.m., while a second crew works from 12:30 p.m. to 8:30 p.m.

The pylon truck, which carries a crew of three, is preceded by the wrecker truck, which ensures safety to the workers and makes frequent stops to turn on or extinguish flashing signs.

The crew manually places 1,200 pylons along the length of the lane and returns a few hours later to pick them up. The morning crew "plugs in the dark," with the help of truck lighting, said Mrs. Myers.

Mrs. Myers said the contraflow workers, particularly those who are working with the pylons, don't have it easy. She said it appears that they are sometimes the targets of drivers who deliberately swerve as close to them as possible to rattle them.

"Sometimes they honk at us or throw things," said Mrs. Myers. "People are real mean, sometimes. If they can't use the contraflow lane, they resent it for tying up traffic."

Then there is bad weather, which can make the job more unpleasant, but Mrs. Myers said, "The rain isn't that bad."

Mrs. Myers gave up driving a Metro bus to transfer to contraflow work, because she prefers the contraflow hours. There's no weekend work, and the early-morning shift gives her ample time to spend at home with her four children ranging in age from 9 months to 16 years.

Before she and her husband moved to Texas two years ago, Mrs. Myers drove a bus for a Chicago-area transit system. She is taking business courses in her spare time and hopes to become a supervisor.

Mrs. Myers is not the only woman to work the contraflow lane, said Feliciano Gonzales, her boss, who praises her as one of the most conscientious workers. Gonzales said most of the workers are former bus drivers who transfer to the division. The pay is about the same, an average $19,000 yearly.

Despite the potential for being hurt, Metro officials said no accidents involving contraflow workers have been reported and workers are nonchalant about the inherent dangers.

"After you get over the initial fear of being out there, it's sort of fun," said Mrs. Myers.

Houston Chronicle 10/11/81

Van-truck wreck in contraflow lane hurts 9

Eight members of a van pool received hospital treatment Wednesday after their van and a tractor-trailer truck collided in the inbound contraflow lane of the North Freeway, Houston police said.

Truck driver James Oscar Acuff, 57, of the 1500 block of LaMonte was treated at the scene for a laceration of the left elbow. Police said Acuff was northbound in the 5100 block of the North Freeway near Tidwell about 6:12 a.m. Wednesday, when a car ahead of him slowed down forcing him to apply his brakes.

The truck went out of control and skidded into the contraflow lane where it collided with the left front side of a van driven by Lester T. Urbanowski, 45, of the 16200 block of Waycreek.

Police said Urbanowski and the other van passengers are employees of the Schlumberger Companies, in the well service business.

The collision caused northbound traffic on the freeway to be detoured along the service road for about four hours until the wreckage was cleared, police said.

Urbanowski's legs were wedged between the van seat and the firewall until firefighters were able to extract him from the wreckage, a fire department spokesman said. He was in stable condition late Wednesday at Heights Hospital, where he was treated for a fractured right leg and a compound fracture of his right arm.

Other van passengers admitted to hospitals were: Wulf Koehlert, 33, of the Woodlands, in serious condition at Citizens General Hospital, where he was treated for eye injuries; Bill Brown, 40, of the 500 block of Mierianne, in good condition at Citizens General, where he was treated for facial abrasions and Billie Tinnin, 50, of the 2300 block of Glade Green, in good condition at St. Joseph Hospital, where she was treated for a fractured pelvic bone.

The four van passengers released from hospitals after treatment were: Alois Weikel, 59, of the 2500 block of Spring Cypress Road; Leroy Springer, 47, of Spring; Dorothy Hughes, 59, of the 200 block of Sulkey Trail and Joan D. Falco, 52, of the 300 block of Hill Road, police said.

The Houston Post/Thurs., Nov. 26, 1981

Metro told contraflow lane in jeopardy

BY NANCY STANCILL
Chronicle Staff

The Metropolitan Transit Authority may have to consider dismantling its North Freeway contraflow lane in the next 20-40 months because of burgeoning off-peak traffic, Metro officials say.

Board chairman Dan Arnold told the State Highway Commission in Austin Monday that the special commuter lane is "rapidly approaching its demise," and urged state support of a proposed $85 million median transitway and related freeway improvements to replace the contraflow project.

Arnold requested commission approval to "proceed immediately with design work" for the North Freeway median transitway for a target completion date of 1985. He also asked the state to join Metro in requesting federal funding and to consider partial state funding.

He said Metro has set aside $4 million for the design work and has done preliminary work with an engineering firm on the proposed 13.1-mile transitway.

The commission agreed to present the project to the Urban Mass Transit Administration and Federal Highway Administration, two agencies which have expressed interest in joint funding of the proposal.

The transitway, a protected 15-foot reversible lane running down the middle of the North Freeway from Beltway 8 to downtown, would replace the contraflow lane, set up manually in an off-peak traffic lane to give priority to rush-hour vanpool and bus commuters.

The 2-year-old contraflow lane, Arnold said, has been a "resounding success," carrying 800 vehicles and 14,000 commuters daily now, or about twice as many commuters as a normal traffic lane.

But a recent Texas Transportation Institute study commissioned by Metro has warned that the lane's "operational life" will be up in 20-40 months because of increasing traffic growth.

For instance, northbound traffic toward Houston Intercontinental Airport is growing heavily, making it a hardship on general traffic flow to forfeit a lane to contraflow. With traffic increasing 5-10 percent annually on the freeway, such continued use is not feasible, the study said.

Metro board members said it would be "a very tough decision" to close down the contraflow lane.

"The timing is extremely critical on this project," Arnold said.

He also emphasized that as traffic increases, so do the inherent dangers to the workers who set up the special lane twice daily and to its users. For instance, he said, eight vanpool riders were injured after an 18-wheel truck hit their vehicle head-on last week.

"Only plastic pylons separate the lane," Arnold said. "It was a miracle no one was killed."

The transitway would be fully protected by concrete barriers, he said, and the three-stage construction project would include adding a regular traffic lane in each direction and would not impede traffic flow during construction.

Officials hope the federal agencies would bear 80 percent to 90 percent of the cost, Arnold said, and Metro could save the $600,000 yearly contraflow operation cost, which, he said, "is throwing money down a rathole."

Two north Harris County legislators, Don Henderson and Clint Hackney, spoke in support of the median transitway, as did Leonard Patillo, executive vice president of the Houston Chamber of Commerce.

"Transportation is the No. 1 concern of people in the northern county, more so even than crime or education," Hackney said.

In a related matter, Arnold chastised the commission for postponing work on a $42 million section of the Gulf Freeway transitway and road widening, originally scheduled next year.

The Telephone to Lockwood section has been delayed until the following year, he said, delaying a 1984 opening on a crucial transitway section.

Commission engineers said the state has spent its 1982 federal entitlement slated for that project.

State to seek U.S. approval for contraflow lane on I-45

By LAURIE PATERNOSTER
Post Reporter

With the State Highway Commission backing the Metropolitan Transit Authority's intention to build an $85 million permanent contraflow lane on Interstate 45 North, it looks as though the ball has bounced into the federal government's court.

MTA chairman Dan Arnold led a delegation of about 13 city, county and state officials to Austin Monday to ask for supporting funds during a special hearing before the State Highway Commission.

Tuesday, Arnold said he had been advised that a commission representative had been authorized to seek federal government approval of the median transitway. If that approval is given, Arnold said, the project will begin immediately.

METRO OFFICIALS ARE hoping to receive funding from two primary sources — the Urban Mass Transportation Administration and the Federal Highway Administration.

The plan calls for construction of a single additional lane down the center of the freeway, between northbound and southbound lanes, protected by concrete walls.

"We are trying to make a permanent contraflow lane because the lane now used for it needs to be, in the next two to three years, returned to regular freeway service," Arnold said.

At present, during morning rush hour one northbound freeway lane is converted to serve southbound vanpools, carshares and Metro vehicles exclusively. A southbound lane serves that traffic northbound during afternoon rush hour.

EARLIER THIS YEAR, MTA committed approximately $500,000 to a feasibility study, he said, and now is prepared to drop $4 million into the kitty for design and engineering on the proposed 13.1-mile roadway.

The project would be constructed in three phases stretched over a period of about three years. The first and second phases would involve 9.6 miles from downtown to North Shepherd Drive, while the third would complete the transitway from North Shepherd to Beltway 8, a distance of 3.5 miles.

Arnold denied reports that the existence of the contraflow lane was in jeopardy, saying Metro was seeking state and federal government financial aid to preclude that possibility.

"I DON'T THINK (the project) is in jeopardy. What we are trying to do is plan far enough in advance so it won't be in jeopardy," Arnold said.

Metro officials hope to receive 80 to 90 percent of the project's funding from the federal and state governments, which would save MTA subscribers about $600,000 a year in operational costs.

"We are fast approaching the critical point in time when contraflow as it exists today will not function properly," Arnold told commission members. "Our forecast for contraflow's operational life is only 22 to 43 months from September 1981."

The two-year-old commuter lanes carry about 14,000 people a day, a 245 percent increase over the last two years, according to Houston Urban Project engineer-manager Bill Ward. During peak hours, he said, the contraflow lane carries as many people as two regular freeway lanes.

"IT'S A VERY SUCCESSFUL operation, probably one of the most successful operations in the country," Ward said, adding that a traffic accident last week punctuated the need for permanent concrete barriers.

Eight vanpool riders and a truck driver were injured last Wednesday when an 18-wheel tractor trailer crossed a freeway lane and the plastic pylons designating the contraflow lane, then smashed head-on into the van. None of those involved was killed.

The purpose of the hearing Monday, Ward said, was to bring home the importance of building that permanent lane.

"WE TOOK THE LANE FROM the highway because traffic going the other way was lighter, but it has been getting heavier," Ward said. "We are now proposing to build a concrete lane down the middle (of the freeway) to take the pressure off."

The Houston Post/Wed., Dec. 2, 1981

APPENDIX D: BIBLIOGRAPHY

A. Houston's North Freeway Contraflow Lane Project

1. Cambridge Systematics, Inc., "Houston Corridor Improvement Project Evaluation Plan," prepared for the Transportation Systems Center, April 1978.

2. Cambridge Systematics, Inc., "Revisions to the Evaluation Plan for the Houston North Freeway Contraflow Lane," prepared for the Transportation Systems Center, February 1980.

3. Taube, Robert N. and Charles A. Fuhs, I-45 Contraflow Interim Report, Metropolitan Transit Authority of Harris County, Report 80-9, May 1980.

4. Texas State Department of Highways and Public Transportation, District 12-Houston, "Feasibility of Contraflow Lanes on I-45 (North Freeway) Houston, Texas," January 1976.

B. Priority Treatment for HOVs--General

1. Priority Treatment for High Occupancy Vehicles in the United States: A Review of Recent and Forthcoming Projects, Ronald J. Fisher and Howard J. Simkowitz, UMTA/TSC Project Evaluation Series Report No. UMTA-MA-06-0049-78-11, August 1978 (PB 294-511).

2. Evaluation of the I-95 Express Bus and High Occupancy Vehicle Priority Systems, University of Florida, UMTA Project Evaluation Series Report No. UMTA-FL-06-0006-78-10, September 1978 (PB 291-146).

3. The Santa Monica Freeway Diamond Lanes--Volume I: Summary, SYSTAN, Inc., UMTA-TSC Project Evaluation Series Report No. UMTA-MA-06-0049-77-12, September 1977 (PB 286-567).

4. The Santa Monica Freeway Diamond Lanes--Volume II: Technical Report, SYSTAN, Inc., UMTA-TSC Project Evaluation Series Report No. UMTA-MA-06-0049-77-13, September 1977 (PB 286-568).

5. Southeast Expressway High Occupancy Vehicle Lane Evaluation Report, Howard J. Simkowitz, UMTA/TSC Project Evaluation Series Report No. UMTA-MA-06-0049-78-4, May 1978 (PB 286-209).

6. A Comparative Analysis of Results from Three Recent Non-Separated Concurrent-Flow High Occupancy Freeway Lane Projects: Boston, Santa Monica, and Miami, Howard J. Simkowitz, UMTA/TSC Project Evaluation Series Report No. UMTA-MA-06-0049-78-2, June 1978 (PB 289-278).

APPENDIX E: REPORT OF NEW TECHNOLOGY

A thorough review of the work performed under this contract has revealed no significant innovations, discoveries, or inventions at this time. In addition, all methodologies employed are available in the open literature. However, the findings in this document do represent new information and should prove useful throughout the United States in designing and evaluating future transportation demonstrations in general, and high-occupancy vehicle contraflow lanes in particular.

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